John Bacon

May 6, 1856

C Cook

Sir Roderick Impey Murchison

D.C.L. M.A. F.R.S. &c.

Director of the School of Science applied to Mining and the Arts.

London D. Bogue Fleet Street

THE

YEAR-BOOK OF FACTS

IN

Science and Art:

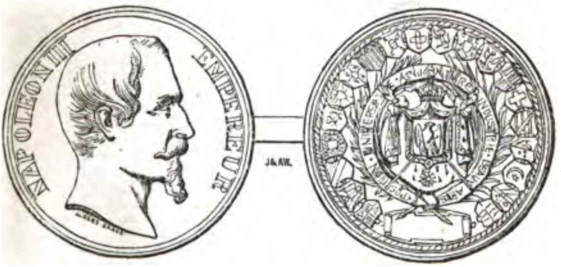
EXHIBITING

THE MOST IMPORTANT DISCOVERIES & IMPROVEMENTS
OF THE PAST YEAR;

IN MECHANICS AND THE USEFUL ARTS; NATURAL PHILOSOPHY; ELECTRICITY; CHEMISTRY; ZOOLOGY AND BOTANY; GEOLOGY AND GEOGRAPHY; METEOROLOGY AND ASTRONOMY.

BY JOHN TIMBS, F.S.A.
EDITOR OF "THE ARCANA OF SCIENCE AND ART,"
AND AUTHOR OF "CURIOSITIES OF LONDON."

"These are but single examples, more striking and palpable than others, of the dependence of the Arts upon the advance of Science."—*Address of the* DUKE OF ARGYLL, *President of the Meeting at Glasgow, in* 1855, *of the* BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.



The Grand Medal of Honour—Paris Exhibition.

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SIR RODERICK IMPEY MURCHISON, D.C.L., Etc.

(*With a Portrait.*)

This distinguished *savant* is the eldest son of Kenneth Murchison, Esq., of Tarradale, in Ross-shire, where he was born in 1792. He was educated at the Durham Grammar School, and at the Military College of Marlow; and received the honorary degree of M.A. from the Universities of Cambridge and Durham. He served as an officer in the army from 1807 to 1816, in Spain and Portugal with the 36th Foot. He fought at Corunna, under the gallant Sir John Moore; he afterwards served on the staff of his uncle, General Sir Alexander Mackenzie, and lastly, as captain in the 6th Dragoons.

"After having served his country as a soldier," says an able writer in the *North British Review*, "Mr. Murchison brought into the field of science all the ardour of his profession, and, after twenty years' unremitting toil, placed himself in the highest rank of modern geologists. When the more recent formations on the earth's surface had been well investigated, and it had been placed beyond a doubt that their age could be determined by their imbedded fossils, it became a problem of the deepest interest to extend the same law to the older sedimentary deposits; to trace the later formations downward to the oldest; to describe the formations which contain the earliest traces of organic life, and to distinguish the strata which compose them from those which had been deposited when no living thing moved among the waters."*

Mr. Murchison's earliest scientific laurels were gained in his native land. Thus, in 1827, he read a memoir on the Coalfield of Brora, in Sutherland, to the Geological Society of London, of which he was then Secretary; and next session followed it by an additional paper on the Oolitic Rocks of that and other parts of Scotland. In 1828, in company with his friend Professor Sedgwick, he communicated to the Geological Society an account of the Secondary Strata of the Isle of Arran; and in the same session, that important memoir on the Old Red Sandstones of the North of Scotland, in which the occurrence of fossil fishes in these deposits was first made known to naturalists. This memoir may truly be described as the starting-point of all that has recently been done in investigating the Old Red Sandstone of Scotland.

Mr. Murchison's researches were now, for a time, turned to foreign lands; as his valuable Memoirs on the Austrian and Bavarian Alps, and on some parts of Tyrol and Germany, amply show. But, in 1831, he returned to British geology, and began those investigations in the west of England which have indelibly connected his name with the most ancient and perhaps most interesting period in the history of the organic beings that have inhabited our planet. In the above year, Mr. Murchison applied himself to a systematic examination of the older sedimentary deposits in England and Wales; and, after five years' labour, he succeeded in establishing what he denominated "the Silurian System," comprehending a succession of strata which lie beneath the Old Red Sandstone, and seem to be in close approximation to the deposits that preceded the existence of plants and animals. This system (named from its occupying those counties which formed the ancient kingdom of the Silures) is divided into the Upper Silurian, consisting of Ludlow and Wenlock rocks; and the Lower Silurian, of Caradoc and Llandeilo rocks. The same succession of the older sedimentary strata was found in the west of Europe, and in North and South America; and Mr. Murchison next traced the extension of the Silurian system to the mountainous kingdoms of Norway and Sweden, and particularly to the vast empire of European Russia, where the relative position of the older rocks has suffered little or no disturbance from the intrusive agency of fire.† After years spent in mapping the rocks, and collecting, classifying, and describing the fossils, the *Silurian System* was at length published in 1839; and, by its full and accurate facts, and clear and lucid arrangement, has, without dispute, formed the basis of all that has subsequently been done in Palæozoic geology, both in this country, on the continent of Europe, in America, and in other parts of the earth.

Under the countenance of the Imperial Government, Mr. Murchison, in company with Professor Sedgwick and M. de Verneuil, in 1846, commenced a geological survey of the Russian Empire; having previously explored several parts of Germany, Poland, and the Carpathians, as intermediate between the British and

* *Men of the Time.* New Edition, 1856. † Ibid.

Russian deposits; and he next examined the Palæozoic rocks of Scandinavia: the results of the entire Expedition were published in two large volumes, in 1845. In 1841, upon the presentation of the first Report upon this Geological Survey to Nicholas, Emperor of Russia, his majesty presented Mr. Murchison with the decoration of the second class of St. Anne, in diamonds, which, however, the Foreign Office in England meanly refused him permission to wear; and the Emperor, as if aware of the slight thus put upon his friend in England, presented him with a magnificent colossal vase of Siberian avanturine, mounted on a column of porphyry, with this inscription:—"Gratia Imperatoris totius Rossiæ, Roderico Murchison, Geologiæ Rossiæ Exploratori, 1842." After three years' additional labour, Mr. Murchison completed his survey of Russia, when the Emperor conferred upon him the Grand Cross of the Order of St. Stanislaus; and upon his return to England, in 1846, thus honoured and accredited, he was permitted to accept and wear the Russian orders, and received the additional honour of British Knighthood.

Sir Roderick Murchison has since republished his *Siluria*, an elaborate volume of 523 pages, containing a faithful outline of his previous labours, with a detailed description, and condensed practical and popular view, of the older sedimentary rocks and their characteristic organic remains. In this work, the author demonstrates by strong and conclusive evidence, that the Silurian System is an independent system, which appears to have been formed in various parts of the globe at one and the same time, of the same rocks and minerals, and inhabited by the same animals and plants. Sir Roderick has altogether established this System with incontrovertible evidence, in Great Britain and Ireland, Germany, France, Belgium, North America, Spain, Portugal, Sardinia, Cape of Good Hope, the Himalaya Mountains, Hindostan, Australia, South America, the United States, Falkland Islands, &c.

A brief notice of this great work was given in the *Year-Book of Facts*, 1855, p. 261. One of the latest labours of the lamented Professor Edward Forbes was the production of a brilliant paper upon Sir Roderick Murchison's work, in the *Quarterly Review*.

Among Sir Roderick Murchison's late scientific investigations was a tour to the North, the results of which are thus characterized by a competent writer in the *Inverness Courier*:—"As the head of the Scottish Geological Survey for the Government, it was his province either to confirm and verify the results of the two years of hard labour he had in 1826-27 among the mountains of Ross and Sutherland, strengthened as his observations then made were by visits to other Highland tracts in 1834, in 1840, and 1850; or else to ascertain that the views of more recent explorers (especially of Mr. Hugh Miller) were more definite and correct than his own. The tendency of Mr. Miller's last descriptions of the quartz rock of the Scarabens of Caithness, and the marble beds of Durness and Assynt, was to classify them all as subordinate or included beds of the great Old Red Sandstone formation, which he has so fully and beautifully illustrated. Sir Roderick Murchison, in his late examination of the country, which involved a double traverse of the county of Sutherland, and one along the whole north coast from Cape Wrath to Thurso, and which has since been extended to the west coast of Ross-shire, has, we understand, seen reason to adhere to the opinion he long ago expressed, and of which he is now firmly persuaded; namely, that the hard crystalline rocks of Sutherland and Ross, which form but one and the same series, are of infinitely higher antiquity than the Old Red Sandstone series, which not only overlaps them unconformably, but is composed or made out of them."

Sir Roderick Murchison's name must be recorded in the annals of the late Discovery of Gold in Australia. In 1844 he instituted a comparison between the rocks of Eastern Australia and those of the auriferous Ural Mountains, and, as a result, he was the first who publicly declared his opinion that gold must exist in Australia.* In 1846 he urged the superabundant Cornish tin-miners to emigrate to New South Wales, and there obtain gold from the alluvial soil in the manner

* In the published Parliamentary Report of the Gold Discovery, all mention of Sir Roderick Murchison's name was omitted; an act of impropriety on the part of the British Government which Sir Roderick very reasonably pointed out; but this omission was explained by the circumstance of the Report having been drawn up by the Rev. W. B. Clarke, who attempted to set up some claim to having made similar prognostications long before Sir Roderick Murchison; but Hargreaves entirely disproves Clarke's assertion. (See *Australia and its Gold Fields*, chap. iv.)

that they extracted tin from the gravel of their native country. Later in the same year Sir Roderick addressed Earl Grey, then Secretary for the Colonies, stating his views as to the existence of rich gold-fields in the above colony.

During the past year, science has sustained a twofold loss in the deaths of the eminent geologists, Greenough and De la Beche, to whose memory Sir Roderick Murchison has paid this graceful and feeling tribute:—

"16, Belgrave-square, April 16.

"The decease of these two eminent geologists having led me to address my valued friend, the Dean of Llandaff (W. Conybeare), on the heavy loss our science had sustained, I have received a reply, from which I extract a few passages, whilst I omit, for personal reasons, certain paragraphs laudatory of those who are endeavouring to fill up the ranks in that body which I had called '*la vieille garde*' of the geological forces:—

"'Now, within six weeks of the close of my threescore and eighth year (writes Dean Conybeare), I must expect to see the allies and associates of the pursuits of my own more vigorous years of life gathered. One of them (Greenough) was my first instructor and guide in our common line, the other (De la Beche) a most efficient companion and collaborateur during my long residence in the most interesting field of Somerset, and the successful completer of all I had imperfectly sketched in the geology of Glamorgan. Perhaps I most deeply feel (as I ought) for my old leader. He was truly the first President of the Geological Society of London, in the widest possible sense of the expression, at the very earliest influx of geological science into England, and he was in every way qualified to take the lead. His long residence on the Continent, his general literary acquaintance with all, and his personal intimacy with many of the principal scientific men, made him the channel of connexion between us insulated folks and our Germanic and French allies; and this alone was one of the points most important at our first start. Then, his sagacity in detecting and industry in collecting all the scattered information that bore upon the physical geography, not of England alone, but of the globe, was in itself truly admirable. His geological map of England is a full record of his work for our country, and his recent map of Hindùstan attests equally his minute and detailed information respecting the most distant localities.

"'Of my later friend and associate, De la Beche, let me say that to his active aid I owed as much in my Saurian researches as I owed to Greenough when I wrote *The Geology of England and Wales*. The Museum of Practical Geology will truly remain the great memorial of his importance in our field, and one which will make his value more and more appreciated every year.'

"The loss of Greenough, advanced as he was in years, was wholly unexpected: for shortly before his death, at Naples, he wrote to me a letter full of animation, kindness, and bright intellect; whilst the departure of my schoolfellow, De la Beche, was daily and mournfully anticipated by many friends, who, like myself, had watched with anxiety the progress of his fatal disease.

"No words of mine are required to raise either of these two remarkable persons in the estimation of their associates, for I well know that their loss is sincerely felt by all those who were acquainted with them; but let me impress on the minds of the general public the deep respect in which we, of the same calling as the deceased, hold the character of the two men, the elder of whom was the first President of the Geological Society of London, the younger the founder of the first great national establishment ever raised in the British isles for the advancement of Natural History science, and especially for the diffusion of sound geological and mining knowledge.

"May the arrangement and classification exhibited in that admirable establishment, as completed by De la Beche and his truly eminent coadjutor Edward Forbes, be vigorously sustained by those who may be appointed to succeed them! Such a proof of our estimation of their labours will be the best testimonial we can offer to their memory.

"ROD. I. MURCHISON."

Sir Roderick has succeeded Sir Henry de la Beche in the office of Director of the Museum of Practical Geology.* During the past year, also, her Majesty's

* Now styled "The Metropolitan School of Science applied to Mining and the Arts."

Government has recognised the well-merited reputation of Sir Roderick, by conferring on him the important office of Director-General of the Geological Survey of Great Britain and Ireland. We agree with a writer in the *Scotsman*, that the above appointment may be regarded as the due acknowledgment on the part of the nation of the value of this important work, the Geological Survey being often merely the completion of the scheme traced out in its maps and sections. The same writer then refers to some of Sir R. Murchison's doings in reference to Scotland: "In 1834 he stirred up the British Association, then meeting at Edinburgh, to urge the claims of Scotland in reference to the Trigonometrical Survey on the attention of Government; and in 1850, when this migratory parliament of science returned to this city (Edinburgh), we find him again instant in the good cause. In all the subsequent movements on this question he has taken a prominent part, ever urging on the more rapid prosecution of the Trigonometrical, and the extension of the Geological Survey to Scotland, and now that he has attained this most influential official position, we have no doubt he will not forget the just claims of his native land."

To this should be added, that at the meeting of the British Association at Glasgow, last autumn, under the able presidency of the Duke of Argyll, the proceedings of the Geological Section were enriched by some very able contributions by Sir Roderick Murchison. Of these papers, abstracts will be found in the Geological section of the present *Year-Book of Facts*.

Sir Roderick Murchison filled the office of President of the Geological Society in 1831, 1832, and 1842, 1843; and President of the Geographical Society in 1844, 1845, and 1852, 1853. He is also a Fellow of the Royal Society, the Linnæan Society, &c.; Member of the Imperial Academy of Sciences at St. Petersburg, and the Royal Academies of Berlin, Copenhagen, and Brussels; Corresponding Member of the Institute of France; Honorary Fellow of the Royal Society of Edinburgh, of the Royal Irish Academy, &c. Sir Roderick has also been three years a Trustee of the British Museum; and during the past year he was appointed to the Royal Commission for the Exhibition of 1851.

Sir Roderick Murchison is the author of nearly one hundred publications on the sciences of geology and geography; his contributions to various scientific bodies dating from the year 1826. Among his latest works is his *Memoir on the Structure of the Alps, Apennines, and Carpathians: The Thüringerwold and the Harz Compared;* and *Siluria, or the History of the Oldest Rocks containing Organic Remains.*

Sir Roderick Murchison enjoys a world-wide reputation for his courtesy and affability to scientific visitors to this country; and his presidential *réunions* of professors of science, art, and literature, take foremost rank among the intellectual hospitalities of the London season.

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THE

YEAR-BOOK OF FACTS.

Mechanical and Useful Arts.

THE UNIVERSAL EXPOSITION AT PARIS.

On May 15, 1855, the Universal Exhibition, or the New Palaces of Industry, on the Seine, were opened with Imperial splendour. In an account of the ceremony, in the *Athenæum*, No. 1438, the writer draws the following parallel with the Great Exhibition of 1851, in Hyde Park :—

The building in Hyde Park was the People's Palace. The buildings in the Champs Elysées are Imperial works. All England contributed its portion towards the house of glass: the Government of France furnished the plans and guaranteed the edifice of stone. From the first of May the million took possession of its own property in Hyde Park, and to the last hour of its existence, hung about it with the love felt for a pet estate. In Paris there is no sense of common ownership, or the respect that springs from ownership, among the multitude. The edifice does not even belong to the Exposition. When the riches it contains are scattered to the four winds, its massive walls will still remain, to be used for—no one knows what purpose. It has a life, therefore, apart from the industrial gathering; and hence the people occupy it temporarily, as they would occupy the Tuileries on the morrow of a revolution, and move about it as they would move through palaces and gardens for a day, on sufferance of the higher powers. In Hyde Park every Englishman felt at home; and his Crystal Palace had the unity, as well as the variety, of an epic.

The Paris Palaces of Industry are three in number—the Central Palace, the Palace of the Fine Arts, and the Palace of Machinery. These are separate buildings, and have various forms. The central building is a parallelogram, with a triple roof of glass, barrel-shape, like the transept of our Crystal Palace :—the middle arch having a wider base, but a less elevation than ours. In this building the ceremonial took place. A long gallery, very narrow for the length, of the shape of a railway tunnel, but well lighted from a partial glass roof, is the Machinery Palace. It runs along the bank of the Seine for three-quarters of a mile, and is particularly ugly when viewed from the steps of the Chamber of Deputies, or the esplanade of the river. But within, it is perhaps the most effective of the three. The Central Palace, nearly square in shape, has no vistas.

The grand feature of the French Exhibition is thus described in the *Literary Gazette*, No. 2000 :—

What nobly distinguishes the Paris Exhibition from that of London, is that it comprises an exhibition of the works of living artists, French and foreign, in painting, sculpture, engraving, lithography, and architectural designs; whereas the London show was confined exclusively to manufactured goods. The collections of the Fine Arts have been placed in a separate building specially constructed for them in the Avenue Montaigne, at some distance from the Exhibi-

tion Palace. This building, though only in lath and plaster, is not without some pretensions to architectural merit, and it is admirably distributed for the purposes to which it is destined. Three large square saloons are set apart—one for Prussia and two for France; one of the latter being called the "Grand Salon," or the "Salon d'Honneur." The English have side saloons to the right which run up the greater part of the edifice; the Belgians and Dutch have the corresponding saloons on the left side; and the French have the remaining side saloons on either hand. Denmark, Italy, Switzerland, and Baden, have the rooms nearest the entry, and Austria occupies a saloon to the right of Prussia. In addition to all this, the English have a large saloon for sculpture, and Horace Vernet, Ingrès, Decamps, have special saloons to themselves. The other countries not here mentioned are provided for in other saloons. The total number of works exhibited is 5028; the number of artists by whom they are contributed is 2004. France exhibits 1832 paintings by 690 artists; 354 pieces of sculpture by 354 sculptors; 191 engravings by 77 engravers; 156 architectural designs by 69 architects; and 95 lithographs by 28 lithographers. Great Britain supplies 231 paintings by 99 artists; 143 aquarelles by 49 artists; 80 pieces of sculpture by 35 artists; 152 engravings by 41 engravers; 18 wood engravings by 11 engravers; 26 lithographs by 6 lithographers; 7 chromo-lithographs by 3 artists; and 126 architectural designs by 51 architects. Prussia contributes 154 paintings by 78 artists; 38 pieces of sculpture by 11 sculptors; and 4 lithographs, 3 chromo-lithographs, 1 architectural design, and 45 engravings by 22 persons. Austria supplies 107 paintings, 91 pieces of sculpture, 24 engravings, 5 architectural designs; Belgium 206 paintings, 25 pieces of sculpture, 16 engravings, 2 lithographs, and 2 architectural designs; the United States 36 paintings, and 3 pieces of sculpture; and Holland 95 paintings, 4 aquarelles, 3 pieces of sculpture, 26 engravings, and 4 architectural designs. Tuscany, once so renowned for pre-eminence in the arts, exhibits only one work—a painting; and amongst "out-of-the-way" countries only two present themselves—Java with one painting, and Peru with five.

It is impossible adequately to describe the surpassing grandeur of this exhibition of the Fine Arts:—it is to the artists now living what the collections of the Louvre are to those that have gone to the tomb. Landseer, Cornelius, Kiss, Delacroix, Couture, and, as already mentioned, Vernet, Nigrès, and Decamp figure in it,—and after them come a host scarcely less worthy, though less famous:—all the great men of the day in fact are there.

The English part of the Exhibition comprised contributions from Leeds, Nottingham, Birmingham, Belfast, Sunderland, Glasgow, Dundee, London, Edinburgh, Dublin, the Pottery districts, and other great centres of our national industry: and the general character of these contributions was not only splendid mechanical skill, but far greater artistic taste than it was the fashion on the Continent to suppose the English possessed. The specimens of our productions from India also made a splendid show. The Belgians made a very creditable display, not only in all the branches of ordinary manufactures, but also in those which from elegance or ingenuity partake of the character of art. The Parisians figured nobly. Austria, Wurtemburg, the smaller states of Germany, and Switzerland, were fully equal to what they were at London. Turkey made for herself an elegant compartment, one of the most charming features in the Exhibition. Tuscany showed marble, sculpture, and painted glass. Russia did not exhibit at all. France occupied the largest place in the Exhibition (the English came next), and her display was, on the whole, the most brilliant of all. Each exhibiting nation had its special district; but the central nave or transept was made common to all. And here were grouped in rich profusion the most curious, the most beautiful, and most extraor-

dinary contents of the Exhibition. Prominent amongst them were a reproduction of the famous apparatus of the Royal Observatory at Greenwich, models of English vessels, specimens of the higher order of English manufactures, and some objects of English art. Here were also some exquisite specimens of Parisian manufactures, some very fine altar-pieces and church ornaments, copies of portions of the architectural ornaments of the Cathedral of Cologne, the apparatus of a lighthouse, collections of arms and cannon supplied by the artillery and the navy, &c. &c.

The Exposition was closed with Imperial state on November 15, when the Distribution of Medals took place; the number of exhibitors who obtained medals or honourable mention being about 12,000.*

In the Report presented to the Annual General Meeting of the Institution of Civil Engineers, held December 18, the Exhibition was admitted to have been, in some respects, more interesting than that of London in 1851. There were better displays from the colonies; the machinery and wrought metals of the continent generally, and the agricultural implements and machinery of France in particular, exhibited great progress; and the foreign machines for textile fabrics showed more attention to accuracy of fitting, and considerable advance in mechanical skill. These features were more apparent, in consequence of the inadequate manner in which many important branches of British industry were represented; for instance, there were only two English locomotives among the twenty railway engines exhibited—fourteen of which, however, bordered on the system introduced by Mr. Crampton. The models of the great works of civil engineering were, with few exceptions, exhibited only by the Ministry of Public Works of France, and by members of the Institution of Civil Engineers; and a well-merited tribute was paid to the excellent and liberal spirit which animated the fourteenth class, composed almost entirely of French engineers, by whom the only two grand prizes of honour were recommended to be awarded to Mr. Stephenson and Mr. Rendel, whilst the decoration of the Legion of Honour had been requested for Mr. Stephenson and Mr. Brunel; and a large number of prizes of honour, and of medals of the first and second classes, and honourable mention, had been awarded to other members and associates of the Institution.

Feeling the importance of the occasion, the Council had not hesitated to deprive the Institution, even for an inconveniently long period, of the services of Mr. Manby, the Secretary, in order to his proceeding to Paris to fill the post of Vice-President of the fourteenth class (civil constructions), as soon as it was found that other members, who had been appointed to the jury, could not attend, and the manner in which the duties had been performed was noticed approvingly.

MACHINERY AT THE PARIS EXHIBITION.

MR. FAIRBAIRN, Civil Engineer, in the capacity of juror at this Ex-

* The Grand Medal of Honour is engraved in the title-page to the present volume.

hibition, collected a series of facts, in connexion with the various forms and adaptations of the objects that came before him; and these he has grouped together in a comprehensive description of the mechanical contrivances displayed in the Exhibition, in such form as to show in what we are different from, and wherein consists our superiority over, those of other countries.*

Mr. Fairbairn proceeds briefly to examine the present state of the Steam Machinery of France and other parts of Europe, in comparison with those of our own in that section of the Exhibition of 1851.

Steam Engines and Steam Machinery.—The number of steam engines in the Exhibition was 112, consisting of 71 stationary, 24 marine, and 17 locomotives, as follows:—

	Stationary.	Locomotives.	Marine.
France	25	6	11
Great Britain	11	2	11
Austria	11	1	—
Prussia	1	1	—
Belgium	1	3	—
Hanover	—	1	—
Wurtemburg	—	2	—
Baden	—	1	—
Sweden	11	—	1
United States	11	—	—
Holland	—	—	1
Total	71	17	24

Stationary Engines.—The department of stationary engines comprised almost all the varieties of construction—horizontal, vertical, and oblique. The horizontal with one cylinder appeared to be much in demand, and the vertical with two cylinders, upon Woolf's principle, having an expansion from four to five times the volume of the small cylinder, had for many years existed in France. This description of engine had been for the last half century in general use in that country, and almost equally so in Belgium and most other parts of the continent. They were worked generally at a pressure of 40 lbs. to 50 lbs. on the square inch, and the steam was supplied from boilers with the fire under the two longitudinal tubes. These tubes were connected with the boiler at both ends, and the heated currents having made two or more circuits of the boiler, made their escape to the chimney in the usual way. These boilers are not, in my opinion, superior in the economy of fuel to those with internal flues, or the tubular system as constructed in this country; but their resisting powers to internal pressure are greater than boilers of larger dimensions. The horizontal single cylinder engines appear to be gaining ground upon the double cylinder vertical engine, and, doubtless, this arises from their superior economy (not in fuel but in price), their compact form, and the limited space which they occupy; and now that metallic pistons are so accurately constructed, the wear and tear upon the cylinders is greatly

* The entire paper, of which the above is the substance, was read by Mr. Fairbairn to the British Association, at their late Meeting at Glasgow, September 12-19.

reduced. The condenser is placed below the cylinder, and the air-pump is worked by a lever attached to the cross-head of the connecting-rod and horizontal slides. The air-pump, like the cylinder, is placed horizontally, and various forms and devices are adopted in order to give the required motion of the feed-pump, and other organic parts of the engine. The valves in most of those engines are of the usual construction, worked by an eccentric from the fly-wheel shaft, but they have peculiar features of a variable laps working through the spindles of the valves, and by a moveable cam which works in a square frame at the end of the spindle, any required expansion can be obtained. This appears to be a very ingenious and a very simple contrivance, and seems to answer the purpose of cutting off the steam at any required point of the stroke. The consumption of coal in this engine is represented to be $\frac{1}{10}$, $\frac{1}{15}$, and $\frac{1}{20}$ kilogrammes of coal, per horse power per hour, or about 3 lbs. English ; and in order to convince the public of the truth of this statement, the makers publicly announced that they offered a guarantee that it shall not exceed that amount.

The application of the horizontal in place of the vertical cylinders is not a new idea ; on the contrary, it is nearly as old as the steam-engine itself ; but the difficulty in former days was the want of tools and accuracy of construction in order to render the working parts smooth and steam tight. This is no longer an obstacle, as the perfection of the automaton tools surmounts all those inconveniences, and hence it follows that the conceptions of former days — for want of the instruments requisite for construction—have remained in *statu quo* up to the present time. In the Paris Exhibition the claimants for originality of design, and the practical application of others previously known, were numerous on all sides ; and although the desire to become an original inventor may in some cases be objectionable, it nevertheless has its use in stimulating that active race to renewed exertions in furtherance of future developments in practical science. The reduced cost and compact form of the horizontal engine is likely to supplant the old vertical system, and assuming the same rate of expansion to be in operation, and the steam to be cut off at one-fourth or one-fifth of the stroke, the result will be—so far as regards the economy of fuel—the same as that derived from the double cylinder, and that by a much less expensive engine in the original cost. In this country these improvements, although well known, are not carried to the same extent as in France ; notwithstanding that the same kind of engine is in operation, they have, nevertheless, made slower progress, excepting only the horizontal non-condensing engine, which is now extensively used as an auxiliary force in most of the manufacturing districts. There is, however, still wanting a well-digested system of the horizontal condensing engine, compact in form, and adapted to the work it has to perform. Much has yet to be done in this way ; and the Paris Exhibition presented numerous examples for our guidance.

Locomotive Engines.—The locomotive engine had its origin in England, and as yet retains its superiority over all others, both in design and construction. It would, however, be illiberal and unjust if we did not accord great merit to the many excellent specimens contri-

buted to the Paris Universal Exhibition. Of sixteen locomotive engines exhibited, nearly all of them were somewhat complex in arrangement and design, but evincing great care and attention to solidity of construction. Many of the engines are upon the system of Crampton, with the valve motions outside, which gives to the engine an appearance of complication that does not occur in those of English construction. In other respects the engines are the same as our own, with the link motions, and other indispensable attachments.

Marine Engines.—In marine steam engines there was little to recommend, as the contributions were very scanty in that department, and would not bear a comparison with those that were exhibited at the Crystal Palace in 1851. With the exception of a pair of neat engines from the Mortala Works in Sweden, two pairs from Cail and Co., and a small pair from Tod and M'Gregor, of Glasgow, for the screw propeller, there was nothing besides models that deserve the name of marine construction.

Hydraulic Engines and Machines.—The turbine appears to have supplanted the water-wheel almost entirely in the estimation of the French engineers and manufacturers; and the millwrights or constructors, availing themselves of the Universal Exhibition, contributed a great variety of articles of this kind. In many parts of France, Switzerland, and Germany—particularly in the mountain districts, where fuel is expensive—the turbine is of great value; and in many parts of the country where water and high falls abound, the turbine is a more convenient and less expensive machine than the water-wheel. On the subject of turbines and their comparative economy, there exists, however, considerable difference of opinion: the advocates for the turbine contending that they are equally effective as the water-wheel, and yield from seventy to eighty per cent. of the theoretical fall. Others, again, contend for superiority and economy in the water-wheel. Mr. Fairbairn has found them range from fifty to sixty per cent. of the actual fall, and in some cases as high as sixty-five to seventy per cent.; but they are certainly not so effective as the breast-wheel when well constructed, yielding, as a well-constructed wheel will do, from seventy-five to eighty per cent. In the turbines there is, however, a considerable reduction in the first cost of the machine, and looking at their great velocity when propelled by high falls, and their relative weights, they are certainly preferable, under certain conditions and certain localities, to water-wheels. In other respects, where the fall of water does not exceed fifty feet, the water-wheel will be found to possess, as far as my experience goes, considerable advantages over the turbine.

Machinery for the Manufacture of Cotton, Silk, Flax, and Wool.—In these departments, namely, the French, Belgian, and Zollverein, several excellent specimens of machinery were found. Some of them were highly finished, and the new combing machine made by the Messrs. Schlumberger and Co., appeared conspicuous for its ingenuity, and the efficiency of its operations. This machine has been greatly improved by Messrs. Hetherington and others, since its first intro-

duction into Manchester and Bradford; and in the preparation of cotton for fine yarns it is one of the most important machines that has come into use for many years. In the combing of flax and wool it is becoming equally important; and in its application to the manufacture of the long wool, alpaca, and the mohair fabrics of Bradford it has at once established its superiority over the system of carding and combing by the old process. The English contributions of machinery are always safe in the hands of such men as Platt Brothers and Co., and the other English contributors. Several newly-improved machines of the very best construction might be seen in the space occupied by the English for the manufacture of cotton. Messrs. Platt Brothers and Co. contributed a complete system of cotton machinery; and Messrs. Elce and Co., of Manchester, did the same, excepting only the blowing and spreading processes, which were omitted; Mr. Mason, of Rochdale, also contributed several specimens of exceedingly well made machines. The machinery fór the manufacture of flax and silk was very imperfectly represented in the English department. Mr. Peter Fairbairn, of Leeds, a large constructor of flax machinery, stood prominently forward in having effected the greatest improvements in his contributions to the perfection of those machines—in fact, his machinery is to the flax manufacturer what Mr. Whitworth's machine tools are to workshops, of the very first quality; and the reason assigned by him for not exhibiting was the enormous expense of showing his very extended series of machines to advantage.

Flour Mills.—The contributions to the Corn Mill Department were numerous and interesting; and the contributors showed no small degree of skill in the numerous forms and devices by which they respectively recommended their machinery to public attention. A flour mill, by Burdon, of five pairs of stones, and driven by a turbine, on the principle of Poncelet, deserved especial notice, from the novelty of its design and the facility by which the stones can be stopped and started. The turbine, with its cistern, is placed below, in the centre of the stones, five in number; the main shaft or spindle penetrates the first floor, and from thence ascends to the top of the mill, and in its passage gives motion to the different machines for dressing, cleansing, elevating, &c.

Special Machinery and Apparatus for Workshops.—The articles contained in this classification comprised a collection of such varied forms and character as to render any process of adjudication extremely difficult, and the distance by which they are separated from each other renders it still more troublesome to arrive at a just and correct decision. . . . Amongst other novelties of the Exhibition was the engine of Mr. Siemens. It is upon the regenerative principle, or that of rendering active the latent heat of steam by a process of applying heat to the steam of the cylinder as it is exhausted at the end of the stroke. This steam having performed its work upon the piston, is discharged through conducting pipes into a second and third cylinder, and these two latter are enveloped by exterior cylinders, having furnaces at the ends, and on which the heat currents of these furnaces impinge, giving to

the lower end a temperature in the interior of almost 500°. This increase of temperature surcharges the steam as it passes from the centre cylinder, doubles its volume, and acting upon the piston or plunger by its expansion, drives it forward ready for the same repetition in the succeeding stroke. The steam, thus expanded and reduced in temperature, is passed by another conducting pipe into the opposite side of the piston, which, acting upon it in a state of saturation, having received some additional heat in its passage through some wire gauze which fills the annular space between the two cylinders over the furnaces, it is again ready for the succeeding stroke. In this way the engine is worked, the steam making a constant circuit, and worked over and over again with about one-tenth of supply from a small vessel or boiler attached immediately above the heated cylinders. The results, according to Mr. Siemens, are highly satisfactory, and produce from the same quantity of coal more than double the force of the steam-engine.

BRITISH RAILWAYS.

Mr. Robert Stephenson, M.P., President of the Institution of Civil Engineers, has presented an address, in which he applied himself to the great question of British Railways, which were described as spreading, like a network, over Great Britain and Ireland, to the extent of 8054 miles completed. Thus, in length, they exceed the ten chief rivers of Europe united, and more than enough of single rails are laid to make a belt of iron around the globe.

The cost of these lines has been 286,000,000*l.*—equal to one-third of the amount of the National Debt.

The Railway works have penetrated the earth with tunnels to the extent of more than 50 miles. There are 11 miles of viaduct in the vicinity of the metropolis alone—the earthworks measure 550,000,000 of cubic yards, which would form a pyramid a mile and a half in height, with a base larger than St. James's Park.

Eighty millions of train miles are run annually on the railways, 5000 engines, and 150,000 vehicles compose the working stock; the engines, in a straight line, would extend from London to Chatham; the vehicles from London to Aberdeen; and the companies employ 90,400 officers and servants; whilst the engines consume annually 2,000,000 tons of coals, so that in every minute of time 4 tons of coal flash into steam 20 tons of water—an amount sufficient for the supply of the domestic and other wants of the town of Liverpool. The coal consumed is almost equal to the whole amount exported to foreign countries, and to one-half of the annual consumption of London.

In 1854, 111,000,000 of passengers were conveyed on railways; each passenger travelled an average of 12 miles. The old coaches carried an average of 10 passengers, and for the conveyance of 300,000 passengers a day 12 miles each, there would have been required at least 10,000 coaches and 120,000 horses.

The receipts of the railways in 1854 amounted to 20,215,000*l.*; and there is no instance on record in which the receipts of a railway have not been of continuous growth, even where portions of its traffic have been abstracted by competition or new lines.

The wear and tear is great: 20,000 tons of iron require to be re-

placed annually; and 26,000,000 of sleepers annually perish; 300,000 trees annually felled to make good the loss of sleepers; and 300,000 trees can be grown on little less than 5000 acres of forest land.

* * * * *

Parliamentary legislation for railways is full of incongruities and absurdities. The Acts of Parliament which railways have been forced to obtain, cost the country 14,000,000*l.* sterling,—the exclusive fault of Parliament itself, and of the system it enforced. The legislation of Parliament has made railways pay 70,000,000 of money to landowners for land and property; yet almost every estate traversed by a railway has been greatly improved in value.

* * * * *

The Electric Telegraph—that offspring and indispensable companion of railways—was next considered: 7200 miles of telegraph, or 36,000 miles of wires, have been laid down at least. Three thousand people are continually employed, and more than a million of public messages were annually flashed along this "silent highway." To the working of railways the telegraph has become essential. The needle was capable of indicating at every station whether the line is clear or blocked, or if accident has anywhere occurred. The telegraph could, therefore, do the work of additional rails, by imparting instantaneous information to the officers, and enabling them to augment the traffic over those portions of the line to which their duty might apply. It also enables large savings to be effected in rolling stock, by affording the means of supplying such stock at any station at which it is needed, from some other station where it has accumulated and is not wanted. The mode in which this system was worked was described, and its simplicity was commended. As a perpetual current is passing through the wires, the guard or engine-driver has only to break the train wire in case of accident, and the officers at the nearest station are instantaneously apprised that something is wrong and that assistance is needed. Some statistics were given to show that the business of the Electric Telegraph Company has increased fifty-fold in seven years.

Railway accidents occurred to passengers, in the first half of 1854, in the proportion of one accident to every 7,195,343 travellers.

The results of Railways are astounding: 90,000 men are employed directly, and upwards of 40,000 collaterally—130,000 men, with their wives and families, represent a population of 500,000 souls; so that 1 in 50 of the entire population of the kingdom might be said to be dependent on railways! The annual receipts of railways now reach 20,000,000*l.*, or nearly half the amount of the ordinary revenue of the state. If railway intercourse were suspended, the same amount of traffic could not be carried on under a cost of 60,000,000*l.* per annum; so that 40,000,000*l.* a year were saved by railways. To the public "time is money," and in point of time, a further saving is effected; for on every journey averaging 12 miles in length, an hour is saved to 111,000,000 of passengers per annum, which is equal to 38,000 years in the life of a man working eight hours a day; and allowing an average of 3*s.* per diem for his work, this additional saving was 2,000,000*l.* a year.

The address concluded with some words of practical application:

The duty devolves on Civil Engineers of improving and perfecting this vast system. Every farthing saved, on the train mileage of the kingdom, is 80,000*l.* a-year gained to railway companies. There is, therefore, ample field for economical appliances, and therefore no economical arrangement, however trifling, is to be neglected. Nothing would afford the President greater satisfaction than that from his observations some sound practical improvement should result to a system with which his name, in consequence of his father's works, had been so largely associated; for, however extensive his own connexion with railways, all he had known, and all he had himself done, was due to the parent whose memory he cherished and revered.

Referring to the benefits derived from the Institution, the President observed that it is the arena wherein have been exhibited that intelligence and familiar knowledge of abstract and practical science, characterising the papers and discussions; in consequence of the constant intercourse within its walls, professional rivalry and competition are now conducted with feelings of mutual forbearance and conciliation, and the efforts of the members are all directed in the path of enterprise and towards the fair reward of successful skill. The business of the civil engineers, from a craft, has become a profession, and by union and professional uprightness a great field is opened to energy and knowledge.*

CHANGES IN IRON.

DR. NOAD states, as the result of experiments made during a recent visit to the Welsh iron-mines, that "The tendency of iron to pass from the fibrous or tough to the crystalline or brittle condition is promoted by various causes; everything, in fact, which occasions a vibration among its particles has this tendency." He then describes his experiments, which prove that the metal may be made to pass from one state to the other:—"Seeing a large quantity of iron chain lying about, and learning that, though scarcely worn, it had been laid aside in consequence of the breaking of some of the links, he examined several from different parts of the chain. He found that a single smart blow with a hammer was sufficient to snap the metal, the fracture of which was crystalline, and its brittleness such that it could, without difficulty, be broken into small pieces under the hammer. Dr. Noad then heated strongly in a forge some of the broken links, and allowed them to cool very slowly underneath a bed of fine sand. After the lapse of twenty-four hours they were examined; the metal was found to have recovered its tenacity; it could no longer be broken to pieces under the hammer; and when at length, after repeated heavy blows, it did partially yield, the texture of the metal was found to be perfectly fibrous—every trace of a crystalline structure had disappeared.

* With the opening of the year 1856 were commenced two weekly newspapers, specially devoted to the profession, namely, the *Engineer*, and the *Engineering Journal*.

MACHINERY FOR MANUFACTURING HOLLOW PROJECTILES.

Mr. R. Peters, engineer, of Southwark, has patented a Machine for manufacturing Ordnance-shells and other hollow vessels, from which excellent results are obtained. His invention consists in the employment of a hollow mould, made in two or more parts, into which metal or other material is poured through a pipe which descends about midway into the mould; and in imparting to the mould, after a sufficient amount of material in a fluid or semi-fluid state has been poured therein, two rotary motions at right angles, or nearly so, to each other. The centrifugal force acting in all directions, distributes the contents of the mould evenly all round the inside thereof; while the internal pipe acts as a vent for the escape of air and gases, and prevents any considerable quantity of material, if any, being forced therefrom. On stopping the two motions, and opening the mould, the hollow article will drop out perfectly formed. When making shells, and if so desired, the inventor inserts round the outside of the internal pipe a ferule screw threaded on the inside. This ferule will become incorporated with the shell, and will be ready for receiving a fuse threaded with a corresponding screw. It may be also necessary to insert a plain ferule round the pipe when forming other articles, to prevent adhesion thereto.—*Mechanics' Magazine*, No. 1689.

SELF-CAPPING RIFLE.

Monsieur Neron, of Paris, has exhibited to the Institution of Civil Engineers an ingenious mode of placing Detonating Caps on the Nipple of a Rifle or a Musket. The apparatus consists of a tube containing twenty-two caps, placed parallel with and close beside the barrel, being partially inserted in the stock, and so arranged, that whilst the near end was attached by a pin to the hammer, the further extremity is free to travel in a slot. Its action is very simple; the tube being filled with caps from a reservoir, several of which occupy but a very small space, the end cover being turned down. On drawing the hammer to half-cock, the tube is drawn forward, until a cap is brought over the nipple, and at full-cock the cap is pressed down upon it. After firing, if any portion of the copper remain attached to the cap, it is removed by a small picker preceding the tube, on its being again drawn forward to repeat the operation.

It is evident that by this simple and cheap addition to any fire-arm, much time must be saved in loading, and a great waste of caps must be avoided; whilst about 25 per cent. of copper is saved in making the caps, and they are kept dry in the reservoir, instead of being exposed to damp, and running the risk of not exploding.

The system is stated to have obtained the approbation of the highest military authorities in France, and with the characteristic alacrity of the Government of that country, to be already in process of adaptation to the Minié rifles, and to fire-arms of all kinds, for the French army.

THE FRENCH, OR MINIE RIFLE.

The following account of the progressive improvements in this formidable weapon are by a Correspondent of the *Atlas* journal:—

It was not until about 1835 that the French Government began seriously to occupy itself on this subject. Capt. Delvigne, of the Infantry, then submitted to the Minister of War a system, the object of which was to suppress the clumsy mode of loading by forcing the ball to the bottom of the barrel with a mallet, and at the same time render the operation easier and quicker, with the advantage of having the bayonet fixed. His plan consisted in having a cylindrical chamber for the powder in the breech, much smaller than the bore of the gun. The charge of powder filled the chamber; and the ball, which entered freely, was pressed down on the mouth of the chamber, and two or three strokes of the ramrod flattened the ball into the shape of an orange, and made it fill the rifle, thus stopping all windage. By this mode much time was gained in loading, the bayonet remained fixed, and there was a great accuracy in firing; but the range was diminished, compared with the musket, in consequence of the flatness of the ball. To remedy this defect, M. Thiéry, Chef d'Escadron d'Artillerie, proposed an oblong ball, which had a much greater range; and this led to the adoption of the present cylindrioconical ball. In 1844, Colonel Thouvenel, of the Artillery, proposed a great modification in the carabine (rifle), which consisted in fixing at the bottom of the barrel a steel cylinder half the diameter of the bore; this cylinder was surrounded by the charge of powder, the ball rested on the end of the cylinder, which was flat, and three strokes of the ramrod (which was hollowed at the end to the shape of the ball) sufficed to make it fit the rifle, and fill up all windage. After innumerable experiments to determine the inclination and the depth of the grooves, their number, and the length of the barrels, which were made by fixing the barrels on a solid immoveable stand, and adjusting them with the greatest precision to the target, the Commission arrived at the most important results that were ever obtained on small arms. The length of the barrels was fixed at 86 cents. (2 feet 9½ inches), the number of the grooves at 4, and their inclination 1 turn in 2 metres; the ball, weighing nearly double the ordinary ball, has three sharp circular grooves on the cylindrical part, which are found to give it greater accuracy of flight. The ball end of the cartridge is dipped in melted tallow, which has the effect of cleaning the rifles, and thus prevents the residue of the powder filling them up. The charge is less than half that used in the musket. Some idea may be formed of the importance of this arm when it is known that at the distance of 1000 metres (nearly 1106 yards), from a target 24 feet long, and 6 feet high, 30 per cent. of hits is the average result of the firing of the *chasseur à pied*. The practical results at the sieges of Bomarsund and at Sebastopol, where the Russian artillery could not show themselves at the embrasures without being killed or wounded to a man, speak enough for the importance of this arm. This is the weapon, with a sword bayonet in addition, which the *chasseurs à pied* and the Zouaves are armed with; it is called *carabine à tige*. The foot artillery are also armed with a short rifle on the same principle.

In 1849, M. Minié, member of the Rifle Commission, and who had taken an active part in all the progressive improvements the rifle

had undergone, proposed to rifle the musket, and employ a ball of his invention, which did not require forcing down, and which might be put in the hands of the infantry—this ball being cylindrical, and terminated at top by an oval-shaped head. By an ingenious contrivance, this ball was made to expand itself and fill up the groves by the explosion of the charge. The part next the powder presented a hollow cone. Its orifice was stopped up by a thin cup of iron, which acted like a wedge, when the explosion forced it into the hollow, and consequently expanded the sides of the ball, and made it fill the rifled grooves—this is called *la balle à culot.* Four regiments were armed with this weapon to try the system on a great scale, and one million of balls (the number fixed by the minister) were expended in trying it at different distances. Although inferior to the *carabine à tige*, the different Commissions were unanimously favourable to the system from its great simplicity and general effect; but as there were a considerable number of bad shots from the ball being torn asunder by the explosion of gas, it was not adopted. Nothing discouraged, M. Minié modified the ball and remedied the defect, and now the Imperial Guard is armed with this weapon.

Thus, after nearly twenty years spent in pursuit of the object, and millions of balls expended in experiments, the French have found a substitute for the defective musket, and which will, no doubt, modify the actual system of warfare. One advantage is, that it can be put into the hands of the common soldier, and it requires but little instruction to employ it. Where gunpowder is employed, it is impossible to foresee *à priori* what will be the result. The following curious incident will show with what care and intelligence the French officers execute the commissions entrusted to them. In the course of the experiments on the *balle à culot*, somebody thought of trying whether the balls would stand the transport necessary for a campaign. Accordingly, a barrel full of balls was sent travelling on the roads round Vincennes, and when they had made fifty or sixty leagues the barrel was opened, and to the astonishment of every one, the balls were found transformed into every imaginable shape. But the new ball made up into cartridges stands travelling on paved roads without showing the least deformity. In the French army, one-third of the officers is taken from the non-commissioned officers, the most capable and the most instructed. With this capacity, it was not likely that M. Minié would remain long in an inferior position. He was in the first formation of the *chasseurs à pied*, a corps created by the Duke of Orleans. The prince duly appreciated his merits, and gave him advancement; and from being a simple soldier he is now *chef de bataillon* (answering to lieutenant-colonel in the English service). He is *directeur du tir* at the Ecole Normale du Tir (shooting school at Vincennes). This is an excellent institution, where the principles of the law of projectiles, in short, everything relative to firearms, is taught. Every regiment, once a year, sends a lieutenant to the school, where, for four months, he studies, theoretically and practically, the principles of firing under able professors. When they return to their regiments they instruct the men, and make them good marksmen. As *directeur du tir* a more competent man could not be

found than M. Minié; his accuracy of firing at any distance within range of the aim is prodigious.

PRINCE'S BREECH LOADER.

In some trials with this improved weapon at Hythe, the distances were from 800 to 200 yards. At the 800 yards three-fourths of the shots struck the target, the bullets being completely flattened. From the effect produced it was stated that even at that distance they would have gone through two or three men, though two drams (avoirdupois) of powder only were used. Not one random shot took place, as even those that missed the target would all have "told" on a body of men. At the 200 yards 26 shots out of the 30 fired were within two feet square, the four outsiders were a few inches high. All, however, would have struck a man.

For the second day's shooting the rifle was intentionally left uncleaned, to test the effect producible from neglect. Fifty consecutive shots were fired at 300 yards, all of which were within a circle of three feet. Eighteen days' shootings next took place, the number of rounds fired varying from 40 up to nearly 200 daily. No miss fire nor stoppage of any kind occurred, though all the experiments were carried on with one rifle and one carbine, 0·577 bore, both being regulation guns, altered to Mr. Prince's plan. Neither did a random shot take place, the very nature of the principle rendering it impossible for the ball not duly to receive the "rifling." The above results being obtainable from weapons possessing greater accuracy and range even than our present Minié, while they are capable of being discharged three times as often, without any counteracting disadvantage, renders their utility beyond all question.

The power of discharging three shots for one, and keeping it up continuously, is most important, not merely for the effect produced, but for the confidence with which men so armed must be inspired.

NEW AMERICAN CARBINE.

Every one who has seen a Dragoon loading a Carbine, on even the most steady horse, must have been impressed with the extreme awkwardness of the process, which required him, in spite of the shying and starting of the frightened animal, to fix a cap upon the nipple, to draw the ramrod, ram down the cartridge, and replace the ramrod before he is in a condition to fire, what, after all, is the most inefficient of all firearms. Most of these difficulties have been surmounted in the construction of the above carbine, tried at the School of Musketry at Hythe. It is the same that is now used by the United States Dragoons. It is perfectly simple in its construction, weighs 7lb. 7oz.; and, although the barrel is but 22 inches in length, it has a range of from 150 to 700 yards. It can be fired with the greatest precision at 400, and in several experiments a 6-inch bull's eye has been hit six or seven successive times at 370 yards. It can be fired with a good aim 10 times per minute with facility, and has been discharged, as a soldier would fire over a parapet, as often as 15. It can be fired almost any number of times without cleaning, and exposure to the

weather has little or no effect upon it. It can be loaded by a horseman without any ramrod, and can be discharged without the trouble of capping. In the hands of proper men, it will give to cavalry the advantages which it has lost by the use of the Minié rifle in the hands of infantry troops. The principle can be applied to any weapon, and, should it be used by infantry, would give them an infinite advantage over an enemy differently armed. The carbine caps itself from a reservoir in the hammer, and is easily and most effectually loaded at the breech.—*Times*, Feb. 23.

IMPORTANT INVENTION IN WARFARE.

It is understood that the late destruction at Sweaborg was chiefly effected by means of Bomb-shells charged with a liquid combustible. We are informed that an invention precisely of the nature of these shells was communicated to Lord Hardinge, in April, 1854, by Mr. William Hutton, writer in Stirling. Mr. Hutton's communication was remitted to the consideration of the Board of Ordnance, with several others bearing on the same subject; and so lately as the 29th August last, the thanks of the Board were conveyed to him for his invention. From the accounts supplied to their Government by the Russian authorities at Sweaborg, as to the operation of the shells charged with liquid thrown into the town by the British fleet, Mr. Hutton is fully satisfied that the Admiralty has adopted his suggestion. Mr. Hutton, has, he believes, discovered another preparation for charging bomb-shells, of a nature so fearfully destructive to human life, that he has resolved not to divulge it. To the same gentleman were the Government, it is said, chiefly indebted for many useful hints with regard to alleviating the sufferings of the army in the Crimea during the course of the past winter.—*Scotsman.*

COLT'S NEW CARTRIDGE.

Colonel Colt, whose revolving pistol now forms a part of the necessary outfit of every officer of the army and navy, has invented a New Cartridge, which, with the lever ramrod, is calculated to render this weapon as perfect as any invention can well be. The cartridge is said to be waterproof, to go off clean, and to be so adapted as to admit of rapid loading. Amongst the many important testimonials recently added to the value of this revolver is one from Colonel J. A. Chalmer, R.A., who, after submitting it to a test of 400 rounds, at ranges varying from 50 to 100 yards, speaks of it as a "good, effective, substantial, and serviceable arm." Lieutenant-Colonel A. Gordon and Captain Sir Thomas Hastings, R.N., in their evidence before the Select Committee on Small Arms, also speak in the highest praise of the efficiency of the weapon.—*United Service Gazette.*

NEW GUN CARRIAGE.

A Gun Carriage, of novel construction, has been experimented with, at Munich, with complete success. Although the carriage is constructed entirely of forged iron, it weighs two cwt. less than the common 6-pounder gun carriage: it therefore requires less manual

labour to detach it from the tumbril, and can be placed in position with greater celerity. But the chief feature of the invention is, that the gun is placed beneath the axle, by which means the chances of upsetting the gun from the inequalities of the field are greatly reduced, as the centre of gravity is placed much lower than in the gun carriage at present used in the artillery.

PATENT BREECH-LOADING CANNON.

THIS Cannon, patented by Mr. J. Maudslay, of Westminster-road, is so made at the breech end as to allow of an oblong aperture being made through the side, sufficiently large to receive a breech piece or charge chamber, which rests on two pivots, so placed as to keep it in balance, and to enable the charge chamber to be easily moved round sideways by a rack and pinion, or other suitable means; in order that the open end of the chamber may receive the powder and shot, and be then turned to its position for firing, where the bore of the charge chamber is in a right line with the bore in the body of the gun. This chamber is also moved forward into close contact with the body of the gun, in order to prevent escape and consequent loss of effect in the discharge, by means of a powerful screw or wedge. For details, see *Mechanics' Magazine*, No. 1668.

WROUGHT-IRON FLYING BATTERIES.

IF thick wrought-iron plates can make effectual Floating Batteries, why may they not make excellent Flying Batteries and approaches against fortifications? This would certainly be a very excellent revival of the old method of attacking castles and walled cities by covered approaches moved on wheels, in which the workmen wielded their battering-rams with terrific effect. We recommend the plan to the contending powers of Europe; it is one which deserves to be tried against the north side of Sevastopol.—*Scientific American.*

IMPROVEMENT IN GUNNERY.

A NOVEL and important Improvement in Gunnery has been exhibited in a series of experiments with a cannon constructed to propel chains and shot in any given direction. The gun is of a peculiar construction, and the chain and shot, when discharged, expand to the full length of the chain and carry everything before them, so that a column of men might be swept down at an explosion. The ground selected was a plain in Battersea park; the cannon used were diminutive models, 9 inches in length and one inch bore. One shot was attached at either end of a chain, 9 feet long; the guns were raised 2 feet above the level of the park, and two targets were placed 20 yards distance to fire at; between the targets and the cannon a number of large sticks were driven into the earth, to resemble a column of men. These arrangements perfected, the inventor applied the match; the powder instantly ignited, and the guns exploded with the desired effect, every stick being swept down. The experiment was repeated several times with the same results; and had the chain been 60 feet instead of 9 feet long, and the cannon of proportionate dimensions, we are convinced nothing within their range

—men or horses—could have remained 2 feet above the ground. We understand the inventor can unite two, three, or more cannon together, pointed as arrangements of an attack or defence might require, and cause them to explode instantaneously by the application of one match. The perfection of such a system of gunnery would, in the present state of our warlike relations, prove of inestimable advantage, and create a new era in the ordnance department of the empire. The inventor is M. Thomas Spargo, Adelaide Chambers, Gracechurch-street, City.—*Mining Journal.*

BRITTEN'S PATENT SHELLS.

Public attention having been drawn to the improved Shells of Mr. Bashley Britten, by his own letters in the *Times*, and by a question put to the Government in the House of Commons by Mr. Roebuck, we publish the following description, from the Specification of the inventor.

"The object of this invention is to increase the range and accuracy of projectiles to be fired from cannon and other pieces of ordnance, by adapting to them the principle of the rifle, or spirally grooved gun; and also to construct the projectiles in such a manner as to provide for their flying with the same point constantly foremost.

"The general form of the projectiles is conical. They are to be inserted in the gun so that the apex or point shall be towards the muzzle, and the base or widest part towards the breech.

"The body of the projectile is made of cast-iron, with a hollow cavity for containing explosive compound, which may be ignited by a common fuse, or other suitable means at the apex. This cavity so situated renders the hinder portion of the projectile of less weight in proportion to size than the fore part, so that the centre of gravity of the whole body will be in front of its greatest diameter, by which arrangement the flight of the projectile will be with its point in advance. A coating of lead, or other soft metal, extends round the circumference of the projectile at this part, and is formed at the hinder extremity. On the explosion of the powder, the edge or wall of soft metal at the circumference will expand, and be driven forwards till it completely fills the bore of the gun; and if the gun be rifled, or grooved, the soft metal will be forced into the grooves, and by following the spiral turn will acquire a rotatory motion, during flight, round the long axis of the projectile.

"The method of coating the projectiles with soft metal in such a manner as to stand the explosive force of the powder is as follows:—The iron is first coated with zinc by the process commonly known as the galvanizing process; and while sufficiently hot to keep the zinc in a fused state on its surface it is plunged into a mould or vessel of suitable form containing the lead, or other soft metal in a fused state, and then allowed to get cold. Care must be taken that the surfaces are free from tarnish or oxide; and the lead should be as near as possible of the same temperature as the zinc."

The inventor states that in experiments made at Shoeburyness on the 26th of July, without at all straining the gun used, his shells, with

little more than half-charges of powder, acquired an effective range of about 1000 yards more than the solid shot of the service with the full charge, while in point of accuracy his projectiles were far superior.

These shells will hold about twice as much powder as the shells of the service, and can be made to explode on striking in the same manner as the Lancaster shells.

"One of the most important features of the invention, is the facility with which it may be adapted, and the economy of its employment. All that is required is a trifling alteration in our present guns, which need not cost more than a few shillings each; and which could be made on board ship just as readily as elsewhere, and which would not weaken the gun or interfere with the use of the service charge when preferred. The gun used in the experiments was a common gun with the alteration.

"The shell would cost but little more than the ordinary ones, and taking into account the saving in some respects, the whole cost would not be greater than that of the ordinary charge for common guns."

Again, Mr. Britten says: "It is now admitted that, on the 26th of July, my shells beat the solid service shot by 1000 yards clear.

"Supposing that my invention had been on this occasion represented by a hostile gunboat, armed with only 9-pounder guns, but having my improvements, and that they had tested the invention by keeping about half-a-mile out of reach of the guns of the batteries, and plied them with my shells, would it, I ask, have been possible to save the place from destruction, even if all the monster service-guns of the arsenal at Woolwich had been sent down by rail, and done their best to save it?"

CAST-STEEL GUNS.

MESSRS. SHORTRIDGE, HOWELL, and JESSOP, of the Hartford Steel Works, Willey-street, Sheffield, have manufactured a Cast-Steel Gun for the Government, with every probability of success. The question of manufacturing artillery, which, without being of such impracticable weight, should greatly surpass in strength, lightness, and durability, the present iron gun, has been urgently forced upon the attention of the Government and the country by the events of the war. Our present artillery is made of cast iron, and it has been found that to secure strength with any degree of durability, the guns must be made of immense weight; and, notwithstanding this, it has been found that the guns have given way after a very limited number of shots, and thus need frequently to be replaced. In a 24-pounder, the pressure of the explosion is 72 tons on each square inch, which is ten times the force of the tensile resistance of a square inch of the metal. The additional strength has been obtained by the large thickness of iron forming the breech, and the tendency of the manufacture has consequently been to increase the disproportion between the thickness of the muzzle and the breech of the gun. The result of experience shows clearly, however, that cast-iron is not the best material of which to make artillery, as it has not sufficient power to resist the repeated percussive action to which it is exposed, especially in siege operations. Experiments have been made, by Mr. Nasmyth and others, to make large guns of wrought

iron; but, from difficulties in the manufacture, these experiments have unfortunately not been attended with success. Guns of small dimensions have for some time past been made of cast-steel, but it has hitherto been considered impossible to make a sound ingot of cast steel of the size necessary for guns of a large calibre. Messrs. Shortridge, Howell, and Jessop have, however, overcome this difficulty by an improvement in the process of manufacture. Their experimental gun is of the size of an ordinary 18-pounder—viz., 6 feet long, 17½ inches in diameter at the breech, and 11½ at the muzzle, with a bore-hole of 5 1-5th inches in diameter; and it weighs in the ingot state 35 cwt., but is intended to weigh only 25 cwt. when bored and finished. The advantage which the gun is expected to possess over our present artillery may be gathered from the following differences in the material:—This cast-steel is six times the strength of cast iron, and twice the strength of the malleable iron in use by the Russians, who in this, as in other matters, have left us in the rear. It is also much less liable to granulate and become weak and useless. The ingot for the gun is, we understand, the largest of the kind that has ever been cast in Sheffield, or, in fact, in the country.

MALLEABLE IRON ORDNANCE.

A Wrought-iron Gun has been manufactured by Mr. Dundas, at Paragon Works, North Britain, on a principle maintained by him to be the only practicable method by which guns and mortars of that material and of large calibre could be made sound and trustworthy; the difficulty of procuring dense and solid forgings of great bulk being well known to every practical engineer. This gun, a 9-pounder, was sent down to Woolwich to be proved. Two heavy charges, of 9lb. of powder and a ball, the usual proof charge of a cannon of this size, were first fired from it. These produced no change in the gun, nor displacement of its parts. Fifty rounds of ordinary service ammunition were then rapidly fired from the cannon, causing no change whatever. The gun was then sent down to Shoeburyness for a further trial; and as thirty-six ordinary service rounds more were fired from it without any remarkable result, the charge was gradually increased to four, five, and lastly to six pounds of powder and two balls. Under this application, the gun at length began to yield, and it finally became unserviceable at the third round of the last series—six pounds of powder, two balls and a wad. In all 152 rounds were fired from it. The following is a brief description of the method of the construction of this gun. Four bars of iron, about an inch thick, five inches broad, and the proper length of the gun, are put up longitudinally into segments of a circle, which if placed edge to edge, form the rough outline of the bore. The edges of these bars are then accurately planed. The bars or staves are then hooped temporarily as a cylinder by means of two rings at the extremities, and turned in a lathe to a surface perfectly true and cylindrical. A series of iron rings, three inches broad and three-quarters of an inch thick, carefully welded, is bored to a size slightly smaller than the barrel or cylinder; these rings, being afterwards expanded by heat, are one by one placed on the cylinder, and plunged into cold water. Instant

contraction ensues, the staves are compressed more powerfully than could be done by any artificial means, and no appearance of a joint in the staves is perceptible. The exterior surface of the mass is again turned perfectly cylindrical, and a second series of rings placed in like manner over the first "breaking band." In the lathe the iron now assumes the exterior of a cannon, the trunnions having been previously placed forged on a centre ring. To bore the gun with great perfection is very simple, as the boring bar can be supported at both ends, and the breech end of the gun being, for a few inches, bored slightly conically with a shoulder, into which fits a solid plug introduced from the muzzle; the cannon is now complete. Since this gun was made, many improvements have suggested themselves to the inventor, who was much in doubt as to the proper proportions required by the separate parts of the cannon, and who, perhaps too confidently, made his gun much slighter than service ordnance of the same calibre, this being one-third lighter than a cast-iron 9-pounder gun. By the substitution of tilted cast-steel for iron staves, further strength is expected; while, by corrugating the cylinder to the extent of from one-eighth to one-sixteenth of an inch, and turning the rings to fit these corrugations when shrunk on, great additional tenacity will be gained.—*Journal of the Society of Arts*, No. 150.

MONSTER MORTAR.

Mr. Robert Mallet, of Dublin, has constructed a Monster Gun or Mortar, which is thus described in the *Dublin Evening Express*:—The attempt to weld together longitudinal bars, so as to form a cylinder, failed in the hands of one of the ablest English engineers, from the circumstance that the long-continued high temperature maintained during the process of welding, produced a tendency to crystallization, and, therefore, was destructive of that fibrous structure essential to the strength of iron for artillery purposes. In Mr. Mallet's mortar the cylinder is former by a series of flat rings, fitting on one another by flanges, and clamped together by strong external bolts. The force exerted by the explosive gas is chiefly lateral, and not longitudinal: that is, it has a tendency to burst the cylinder in a direction at right angles to its axis, and only a small force comparatively to separate these rings in a direction parallel to the axis. Of one of these mortars, completed at Millwall, and the shell cast, the dimensions are startling. Instead of the 13-inch shell (the largest hitherto) weighing about 200 lb., and carrying about 30 lb. of powder inside, we are to have a shell of 36 inches diameter, weighing about 2,400 lbs., and charged with half a ton of gunpowder. The range is stated to be about half as far again as that of the 13-inch mortar.

RUSSIAN INFERNAL MACHINE.

The following details of this war implement are from a Report of some Machines taken up in the Baltic; when Admiral Seymour, examining one on the poop of the *Exmouth*, incautiously tapped a little bit of iron which projected from its side, saying, "This must be the way they are exploded," when the machine went off, and everybody

round was scattered on the deck, and more or less burnt. Each machine consists of a cone of galvanized iron, 16 inches diameter at the base and 20 inches from base to apex: it is divided into three chambers; the one near the base being largest, and containing air, causes it to float with the base uppermost. In the centre of this chamber is another, which holds a tube with a fuse in it, and an apparatus for firing it. This consists of two little iron rods, which move in guides, and are kept projected over the side of the base by springs, which press them outwards. When anything pushes either of these rods inwards, it strikes against a lever, which moves like a pendulum, in the fuse-tube; while the lower end of the lever breaks or bends a small leaden tube, containing a combustible compound, which is set on fire by coming in contact with some sulphuric acid held in a capillary tube; this is broken at the same time, and so fires the fuse, which communicates with the powder contained in the chamber at the apex of the cone, and which holds about 9 lbs. or 10 lbs. At the extreme apex is a brass ring, to which are attached a rope and some pieces of granite, which moor them about nine or ten feet below the surface, so that the only vessels they could hurt, the gunboats, float quietly over them, and, now we know what they are, they have been disarmed of all their dread. But they prove dangerous playthings: the Commander-in-chief was examining one of the fuse-tubes that was supposed to be spoilt, for it was full of mud and water, when he accidentally touched the lever, and it exploded in his hands, scattering the mud into the faces of all present.

GUNPOWDER EXPLOSIONS.

At a Meeting of the American Association for the Advancement of Science, Professor Olmstead read the following paper on the Wilmington (U.S.) Gunpowder Explosion. "On the 31st of May, 1854, three wagons from Dupont's mills were passing through Wilmington, Del., each with 150 barrels of gunpowder; about 12,000 barrels in all exploded, demolishing buildings and destroying life. These wagons were accustomed to pass that route daily for fifty years. The regulations prescribed had fallen into disuse. They had left the mill at distances of half-an-hour, but had got within twenty-five feet of each other. Wishing to trace out analogies between this explosion and some phenomena of tornadoes, Professor Olmstead wrote to Bishop Lee, whose house was destroyed, and received in answer from his son some interesting facts. The cause of the explosion does not appear, but it is known that two of the men were smoking by the side of their teams. Some of the phenomena were surprising. A splinter from a Venetian blind was blown through an inch board, making as smooth a hole as if pointed with steel. Metals were often displaced. The shoes were torn off the horses' feet, castors from furniture, and hinges from doors, and a wagon-tire was torn off and straightened, and one piece left on a hill a quarter of a mile off. Windows were destroyed for the distance of more than a mile. Those near the spot were burst in, those further off had the nearer windows burst in, the others out; those further off were all burst out. A piano opened near the spot was little injured; one *closed*, further off, was burst open and nearly

ruined. The effect on the animal system was to produce a sense of suffocation at first, and afterwards soreness of the throat, or even hæmoptysis. Many were carried some feet and dropped erect. A man on horseback was lifted out of the saddle and dropped into it again. But the most wondrous effect was exhibited by three depressions where the wagons had stood. The one under the middle wagon was ten feet by five, and three feet deep. It appeared that the earth (macadamised) had not been removed but condensed. Professor Olmstead knew of no instance of greater power, even in the great explosion of Brescia, where two millions of pounds of powder exploded, that equalled this. Iron water pipes were broken four or five feet underground. In the New Haven tornado of 1839, a piece of bureau was carried half a mile, and found sticking into a barn, having penetrated through a thick plank. Feathers have been stripped off fowls, and a woman washing found herself and her tub, with its water, in the cellar, while some of the clothes she was washing were found beyond West Rock, a distance of two miles. Fowls have been known to be stripped of their feathers in such tornadoes." Professor Mahan said, that sappers and miners had a rule that the lateral force of an explosion would destroy the works at three or four times the distance to the surface, and the downward force would do the same to three quarters the distance of the surface. Professor Henry said that the shoes were not blown off the horses' feet, but that the horses were blown away from the shoes. Iron has a specific gravity of about seven times that of an animal body. Mr. Wm. C. Redfield saw no satisfactory evidence of a vacuum. Causes are often mistaken, but he had never found any clear evidence of a vacuum, though so much had been attributed to such a cause. Professor Brainard thought many phenomena resembled those of electricity, as stripping doors of their hinges and birds of their feathers. Professor Loomis thought the indentation in the ground was analogous to the process for submarine explosions, only as the resistance of water is greater than air, the force is proportionally greater. As to feathers, the loss of them has been attributed to vacuum, but a fowl suddenly exposed to vacuum loses no feathers. Professor Loomis put a live fowl into a gun of two-inch bore, with a sixth of a charge of powder, and aimed at zenith. It came down denuded of feathers and mangled by using more powder than was necessary. Professor Johnson thought there was an analogy between the indentation of gunpowder here and that often exhibited by more violent fulminates. Two ounces of fulminating mercury will perforate an inch plank when there is nothing to oppose it in any direction. Professor Rodgers thought that there never could be any condensation of air by explosion without a subsequent rarefaction, and that vacuum played a necessary part of the phenomena of tornadoes."

CAPTAIN NORTON'S RECENT INVENTIONS.

CAPTAIN NORTON has explained, at the United Service Institution, the following Inventions, when also he exhibited models, the more clearly to illustrate them:—

1. Fog-alarm signal, to be placed on the rails. This model is merely stuffed with paper: the unfilled varnished waterproof papers show the stages of forma-

tion. It is evident that it cannot *rust* or become damp, neither is there anything to *fly* and cause injury.

2. Whistling bolt, to be shot by the guard of a train, high over the head of the engine-driver, or on one side of him. The cartridge is attached to the inner end of the bolt, and is fired without previous opening.

3. Fire-ball bolt. The quick-match is placed between the shaft and the ball; the latter of course can be made to produce either fire or flame.

4. Explosive percussion-bolt signal. The igniter is the *last* inserted; and the bolt falling on grass or soft clay, is sure to explode by the fracture and consequent friction of the glass-tube igniter.

5. Elastic expanding sabot. Its base is fortified by a circular piece of sole, or stout leather, glued on with gutta percha, or other cement. With this sabot *iron* shot may be fired from a rifle, or other gun, without injury to the rifle or bore of the gun.

6. Cartridge—that does not require to be opened previous to or in the act of loading; it can be drawn when required *entire*, without losing any portion of the powder, and is peculiarly well adapted to Sharp's breech-loading rifle, as it does not require to be *cut* by the action of the closing lever, as his present cartridge does.

7. Implement for firing cannon, without a vent or touch-hole. It is easily fitted on at the mouth of the gun, and the firing of the gun cannot derange it.

8. Shot or shell, made of pressed clay, artificial stone, or glass, for artillery. It will be efficient against all but stone walls; the application of the elastic-sabot *cushions* it in its passage through the gun, and prevents the palpitations that might otherwise fracture it.

9. Frictional exploding signal, that may be thrown from the hand, and caused to explode at the end of a cord high in the air. It can be used to warn a train *following*, not to run into a train brought to a stand by an accident, as in the melancholy case near Straffen.

10. Glass-tube igniter. When charged with percussion powder, or lucifer composition, the ends are closed with cork, glued with liquid glue.

11. Sabot, made of pressed leather, so as to fit on the lower end of an elongated shot or spherical ball.

12. Improved cordage, so as to give greater strength to the strands forming the rope, cord, or band; the strands are cemented together by a solution of gutta percha, with a slight or no twist.

13. Rifle arrow, or bolt, adapted to Sharp's American breech-loading rifle. This has been shot to the distance of nine hundred yards; the cartridge may be attached to it, so as to lie in the barrel without cutting off the end and *spilling* some of the powder over the jointure of the breech, as is the result with Mr. Sharp's cartridge, which is attached to his shot. This bolt is peculiarly efficient for vertical fire, to dislodge an enemy from behind strong buildings, ramparts, or other cover.

14. A shell, with a frictional igniting cord attached close to its *short* fuse, to roll down a glacis or other sloping ground, and explode among assailing troops at the end of the cord by the strain of the momentum.

15. A *safe* means for forming percussion shells for cannon. This shell may be let fall, *point foremost*, from the topmast on the deck of a man-of-war, and it will not explode; but if afterwards, without any alteration, it is allowed to fall from the same height into a tub of sand or clay, it will explode: the reason is, that the percussion appliance being *below* the orifice in the shell, it is not *pressed* upon in the first instance, but in the second is.

16. A brass tube, to demonstrate the principle of his improved cartridge. This is done by putting a little gun-cotton into a small piece of tough paper, such as cartridge paper, and then inserting the paper into the tube, keeping the cotton-charged end of the paper about the eighth of an inch apart from the end of the tube, then applying a heated poker to the cotton-end of the tube, but without coming in contact with the paper, when the gun-cotton will explode without *bursting* or soiling the paper.

17. Rifle fire-shot, or spinster. This shot, of the cylindro-conoidal form, and weighing about two ounces and a quarter, was shot to the distance of *eighteen hundred* yards, from a rifle of the eleven calibre, the charge of sporting powder about five drachms, and the elevation about thirty degrees, so as to give the longest range.

18. A model of the form of the shot that should be used from a two-groove

rifle cannon. It is the same which is described by a diagram, No. 12, in his pamphlet on "Projectiles;" the punch formed head only to be made conoidal.

19. A case representing his improved manner of forming drains in land, by *round* well-burnt clay-balls, about four inches in diameter. These, as they can only touch one another at the *points*, will allow a free passage for percolating off the water.

20. A fuse-case, turned from artificial wood, made by hydraulic pressure from prepared saw-dust.

21. *Concussion*-fuse for shells of the largest size. A select committee of Artillery officers, at Woolwich, about nine years ago, reported *officially*, that it was "simple, safe, and efficacious, being well adapted for horizontal fire at high velocities."—See fig. 7, in his pamphlet on "Projectiles."

22. An instrument for compressing sabots made of leather, cork, tow, or other matter, into the required form.

The whole of these models are permanently exhibited at the Crystal Palace, the Polytechnic Institution, and the Panopticon.

RUSSIAN FIELD MINES AT SEBASTOPOL.

THE following account of the small Mines which the Russians planted thickly about their advanced works at Sebastopol, and which were exploded by the touch of the foot, is given in a communication by the Correspondent of the *Times*:—

"A strong case containing powder is sunk in the ground, and to it is attached a thin tube of tin or lead, several feet in length; in the upper end of the tube there is enclosed a thin glass tube containing sulphuric or nitric acid. This portion of the tube is just laid above the earth, where it can be readily hid by a few blades of grass or a stone. If a person steps on it, he bends the tin tube, and breaks the glass tube inside. The acid immediately escapes, and runs down the tin tube till it arrives close to its insertion into the case, and there meets a few grains of chlorate of potass. Combustion instantly takes place; the mine explodes, and not only destroys everything near it, but throws out a quantity of bitumen, with which it is coated, in a state of ignition, so as to burn whatever it rests upon. Later in the day, I very nearly had a practical experience of the working of these mines; for an English sentry, who kindly warned me off, did not indicate the exact direction till he found he was in danger of my firing it, when he became very communicative on the subject. One of them blew up during the armistice, but I do not know what damage it did. We have lost several men by them. While the ground is occupied by the Russians, they mark them by small flags, which are removed when the enemy advance. It makes it disagreeable walking in the space between the works."

PORTABLE IRON BARRACKS.

MR. SAMUEL HEMMING, of the Clift-house Factory, at Bow, has contrived an Iron Barrack to accommodate fifty men, which, upon inspection, seems to deserve the attention of Government. The erection is in length 78 feet, and 19 feet in breadth, in the interior, and it occupies a space of ground 80 feet by 40 feet, having the earth heaped against each side, to the thickness of several feet outside, and sods of earth laid over the arched roof, so as to present the appearance of a mound or hillock, to a distant observer. A regiment might walk over

it, and do it no harm. The house is sunk about three feet, the soil being excavated to that depth like a cellar. No cannon shot, thrown horizontally, could penetrate the sloping earthen bulwark and side of the house, except near the ceiling, so that the soldiers, when lying down or sitting in the house, would be secure from anything but shell firing on the side next their enemy. On the other side openings are left in the earth for the glass windows. The ceiling is 9 feet above the ground, in the centre, and arched on each side so as to join the walls, which are 3 feet high above the excavated part. At this level a wooden shelf runs all round, and above it a row of pegs. The beds, having a width of 4 feet each, and 25 on each side, would be placed at right angles to the wall, their feet towards the middle of the house, where a wide passage would still be left. Along the middle the roof is supported by an iron pillar or rod, an inch and a half thick, at every 10 feet. The tables, which are wooden, may be hoisted up by pulleys in the ceiling, and their legs folded. The whole structure is composed of plates of corrugated iron, the plates of the sides being 6 feet by 3, and the curved plates of the roof 7 feet by 2, so that three of the roof plates, end to end, span the entire arch. The plates are screwed into a wooden beam, which can be done more easily, and with less chance of being deranged, than if they were screwed into holes in the iron, but the whole structure is perfectly compact, and its foundation secured by angular pieces of iron at the sides, sunk in the earth outside. There is a door and a window at each end, and holes in the roof for ventilation are made at every 10 feet. The cost of such a house as this is 130*l.*, about 30 per cent. less than such a wooden hut as would accommodate the same number of men, according to the pattern of those in our camp at Sebastopol. Its weight is only 5 tons and a half, but the great economy of it is in the stowage on board ship. The iron houses are more easily put together, and without any risk of shrinking, splitting, or otherwise spoiling the materials. They are weather-tight, and warm beneath the mass of earth in which they are imbedded, and the rain cannot get in.

THE FRENCH FIELD-HOSPITALS, OR AMBULANCES.

THE word *Ambulance*, or field, or flying hospital, is very familiar to most of our readers; but many are, perhaps, not aware of the actual manner in which these hospitals are organized and conducted.

The principle upon which the whole arrangement rests is, that the medical officer—viz., the scientific man, should not be harassed with anxiety about stores and packages, and that those matters should rest entirely with responsible agents, whose duty it is to attend to his directions, within the limits of the regulations. Hence we have the following practical divisions:—

The medical officer at the bed-side is invested with the whole control and management of his patient. The pharmacien, upon the surgeon's prescriptions, prepares the medicines; the clerk sees to the procuring and proper use of the required articles of furniture, and to the carrying out of the diet-cards filled up by the medical officer; the ward attendant takes the immediate charge of the sick or wounded man; the

sisters of charity and chaplains aid in the work of benevolence and kindness; the assistant-commissariat officer, who receives orders from his superior, watches over the management of the whole; and the regular working of all these secures a perfect unity of action.

The ambulances, temporary hospitals, and convalescent depôts are intended, during a campaign, for the reception of the wounded or sick soldier. If the seat of war is too distant from the frontier of France, where hospitals are organized for the reception of the sick or convalescent, an eligible locality is chosen for the erection of temporary hospitals; hence the great central nosocomical establishment of Constantinople. Now, these various modes of relief for the soldier—viz., the ambulance, the temporary hospital, the convalescent depôt, and the permanent hospital, have each a peculiar organization.

The ambulance is the moveable hospital which follows the army in all its movements. There are ambulances for the infantry, and others for cavalry—all connected with the different divisions. At head-quarters there is, besides, a reserve of surgeons, and two ambulances of infantry and one of cavalry, always ready to go forward at a moment's notice. It was important, in order to insure lightness and rapid movements from one place to another, to arrange the packages so that they might not prove cumbrous under any circumstances. Everything must, therefore, be reduced to the least volume, and all the requisites for dressing wounds are disposed in panniers, the weight of which is so calculated as to suit the strength of the pack-horse, in case the usual wagon breaks down, or cannot be got through a difficult country.

Only five carriage boxes are allowed for the reception of the following articles:—amputation and trephining cases, tents, litters, splints, solidified broth, brandy, linen and lint, medicines, &c. These five boxes or cases constitute an infantry ambulance, and provide 8900 dressings. Three cases, with 4900 dressings, form a cavalry ambulance. These ambulances are subdivided into active and reserve sections. The reserve section, which comprises two cases for the infantry, and 3500 dressings; and one case, with 1500 dressings, for the cavalry, remains generally with the wagons attached to the corps, and is kept ready to supply the active section with any article that may be wanted. The latter is again subdivided into ambulance depôt and flying ambulance.

The depôt ambulance settles down at a convenient distance from the battle-field, and the attendants immediately take down the cases from the wagons, prepare the linen, lint, dressings, &c. They light a fire, and immediately make, with their solidified broth, a good saucepanful of soup. This is called the precaution soup, and thus they have at once what we should call beef-tea for the wounded. Everything being thus prepared, a red flag is unfurled, to apprize the wounded men where they can get relief. The flying ambulance goes, in the meanwhile, to the immediate rear, within the enemy's range, to attend to the men who receive dangerous wounds. At the same time clerks, under the command of commissariat officers, and accompanied by medical officers, proceed along the lines, and cause the wounded to be taken up by the attendants and the drivers. This latter arrangement is especially intended to prevent the soldiers from yielding to compas-

sion, and succouring their fallen comrades, no man being allowed to leave the ranks, however desirous of aiding the wounded.

The ambulances just described are called the European ambulances, but there is another kind, called African ambulances, which latter have been instituted to serve in countries devoid of roads and destitute of accommodation. An ambulance of this kind, calculated for a corps of 10,000 men, contains 6500 dressings, and requires 364 pack mules. Twenty-four of these carry iron litters, on which soldiers who have had a limb amputated may be placed; and 250 carry little arm-chairs made of iron and leather, which may be unfolded, slung, and fastened to the pack-saddle, and will take a patient on each side of the mule. The rest of the mules carry the casks of diet drinks, the stretchers, the blankets, the leather covers for the sick, the tents, the surgical boxes, the cases containing the drugs, &c. Sixteen medical officers, 7 clerks, and 104 attendants on the sick or wounded, are attached to this ambulance, which is mainly intended by its fleetness for vanguard service, and for picking up the wounded on the field of battle. Both the European and African ambulances are being used in the Crimea with the best effects.

Light carts have also been sent to the seat of war. Three wounded men can be accommodated on the front seat; there is a case behind, properly secured, which is so made as to contain 2 stretchers; and boxes, surrounded by wire-work, are intended for the guns and sacs of the soldiers.

Such are the characters of the ambulances, the peculiarity of which is, to move rapidly from place to place, and to be ready for all the emergencies of war. Thus, before Sebastopol, the ambulance placed in the trenches receives the wounded immediately they are struck, and these are sent, after the first dressings are applied, to the ambulances placed behind the lines. Hitherto, all the sick and wounded were attended to in the latter ambulance until they could be removed to Constantinople; but General Canrobert established a temporary hospital on the beach of the bay of Kamiesch, which hospital accommodates 500 patients. By this and other means, 10,000 either wounded or sick soldiers have received, though 800 leagues from their country, the same attention as they would have at the Val de Grâce or Gros Caillou in Paris.—*Lancet.*

PROTECTION OF THE NEW PALACE AT WESTMINSTER FROM LIGHTNING.

In the published Estimates of Civil Services (chap. 1) for the year 1855-6 there is a charge of 2314*l.*, for Works necessary for Protecting the New Houses of Parliament from injury by Lightning, to which an explanatory Report is appended by Sir W. Snow Harris. In a notice of this subject, the *Times* of April 23 has the following remarks:—

Sir Snow Harris, in his present Report, once more refutes the fallacy of the vulgar and unphilosophical assumption that lightning rods "attract" the lightning, and so act as efficient safeguards. It is proved by a most extensive induction of facts, and a large generalization in the application of metallic conductors, that metallic substances have not exclusively in themselves any more attractive influence for the agency of lightning than other kinds of common matter; but that, on the

contrary, by confining and restraining the electrical discharge within a very narrow limit, the application of a small rod or wire of metal to a given portion of a building is, in reality, highly objectionable. Besides, the application of an ordinary lightning rod is of a very partial character; it has small electrical capacity, and is very often knocked to pieces by heavy discharges of lightning. To mention only a few recent instances out of several adduced by Sir Snow,—last June, Ealing church was struck by lightning, the small conductor attached to the tower was partially fused, and damage ensued. So again, in July, a church at Astbury was struck, and the small conductor fused in several places, the discharge dividing on the body of the church, and displacing and shivering several stones. In her Majesty's navy conductors of this description have been repeatedly knocked in pieces by lightning. To secure such a building as the New Palace at Westminster against lightning, Sir Snow considers it requisite to complete the general conductibility of the whole mass, and so bring it into that passive or non-resisting state which it would assume in respect of the electrical discharge, supposing the whole were a complete mass of metal; by which means a discharge of lightning in striking upon any given point of the building would have, through the instrumentality of capacious electrical conductors, unlimited room for expansion, upon the surface of the earth, in all directions to which, by a law of nature, the discharge is determined. "In fact," to quote from the text of the Report, "what is called lightning is the evidence of some occult power of nature, forcing a path through substances which offer greater or less resistance to its progress; such, e.g., among the former, as atmospheric air, vitreous and resinous bodies, dry vegetable substances, and such like. In the case of such bodies a powerful evolution of light and heat attends its course, together with irresistible, expansive, and disruptive force, by which the most solid and compact structures are rent asunder; whereas, in finding a path through substances which offer comparatively little resistance to its course, this explosive form of action, which we call lightning, becomes transformed into a harmless and unseen current; hence, the great productive influence of a capacious and general system of conduction, such as that just adverted to, which does not restrict the discharge to a given partial and narrow path, but is so circumstanced that lightning striking anywhere upon buildings cannot enter upon any circuit of which the large capacious lines of conduction do not form a part."

Such are the principles on which Sir Snow Harris recommends his metallic conductors to be applied in the great mass of the buildings constituting the New Palace at Westminster; and which, he feels assured, will effectually secure those buildings from the effects of lightning both for the present and for all future time. Now, the general surface of the roofs of the palace being iron coated with zinc, and connected with the earth by iron waterpipes in very many places, fulfils, to a great extent, one of the important conditions of the general conduction required; and thus the large mass of the roofing may be deemed as virtually a portion of the earth's surface electrically considered. It is only necessary, therefore, to provide for the several por-

tions of the building above the general level of the roofs, and to make up, by capacious conductors of copper, for the comparatively low-conducting power of the roofs and the cast-iron pipes which connect them with the earth. The elegant central tower, for instance, is 150 feet above the general level of the roofs of the palace; and Sir Snow recommends that a capacious conductor of copper tube of two inches diameter, and at least one-eighth of an inch thick, be fixed within the upper part of the tower, in its south-west angle, from the large copper terminal which surmounts it to the level of the roofs of the buildings generally; that this tubing should be effectually secured at the joints over solid screw plugs and coupling-pieces, and secured to the masonry by metallic staples. At the junction of the tower with the roofs, Sir Snow would recommend this copper tubing, after being well connected with the metals of the roof, to be continued externally to the earth in as straight a course as possible, and there terminated by one or two projecting branches of solid copper rod. The reason assigned for continuing the copper conductor as a whole into the earth (the soil of which should consist of carbonized matter as far as possible), instead of terminating it in the metals of the roof, is this—viz., that the electrical discharge would have a line of the same conducting material throughout, and not have to leave a high for a lower conducting power. Throughout the entire height of the Victoria and Clock Towers (300 feet from the ground) Sir Snow recommends that a copper band of conduction, similar to the conductors applied in her Majesty's navy, five inches wide and 3-16ths of an inch thick, be fixed and secured to the walls; the band to be properly connected with the metal bodies of the roofs generally, and also with the metal rail of the staircase within each tower. The north and south towers in the centre of the portion of the river front will also require special protection, by attaching bands of sheet copper from the vanes to the roofing beneath, and from these conductors constructing an independent line of the same metal, to be continued to the earth. The north and south wing towers of the river front should be treated similarly. In the ventilating shaft of the House of Commons, where a coke fire is generally in operation, it is recommended that a tubular conductor should be fixed on the east side of the shaft, and connected with the metals of the roof, as, otherwise, the ascending rarefied column of warm air might determine the course of a stroke of lightning in the direction of the shaft. Lastly, the ornamental turrets and pinnacles of St. Stephen's Porch should be protected by small bands of sheet copper, two inches wide, and one-eighth of an inch thick, neatly attached to them, and placed in connexion with the metals of the roof below.

These recommendations are the result of serious deliberation, and Sir Snow believes that they are absolutely requisite. The instances of various church spires struck by lightning and ruined are adduced in support of his views. It is worthy of remark, as illustrative of the deplorable ignorance which exists on the subject, that on the spire of Christchurch, at Doncaster (struck in the year 1836), a ball of glass had been placed, under the notion that glass, because a non-conductor, is also a repellent of lightning.

ARTILLERY AND PROJECTILES.

At the late meeting of the British Association, a considerable portion of the Sittings of the Mechanical Section was devoted to the above all-engrossing subject, in connexion with the great War in which we are engaged. First, a paper by Mr. W. B. Adams, was read by Mr. Ward. It gave a description of various kinds of projectiles, and the philosophical reasons why gun-cotton is better for blasting rocks than for gunnery. The first guns in use in all countries were long; but the inconvenience of very long guns was the cause why the length was curtailed, and why also carronades and mortars were invented. The paper then went on to describe the material of which Artillery should be made, and the proper mode of manufacture, and an improved trunnion, with some original suggestions regarding the form of wadding and shot best suited to give sure aim and increased velocity and penetration. In giving his idea of the best form of a ball, Mr. Adams thought that the conical form, with feathers, was the best, which is exactly that which Mr. Kennedy, of Kilmarnock, has lately patented, and which has been experimented upon lately at Ardrossan and Troon. The idea of an elongated ball, which should also be charged like a bomb, has also been anticipated by Mr. Kennedy. Welded guns, united by hydrostatic pressure,—the coating inside with another metal to prevent abrasion,—and several other improvements, which have in part been adopted by inventors, were also recommended.

Dr. Robinson was of opinion, that feathers upon a ball was a mistaken idea, because the ball carries with it a portion of air, and that rotation could not be secured to the ball by feathers alone, as they could not act but on the body of air which they carried with them. Rifled guns are more liable to burst, because the force necessary to explode a ball from such a piece of ordnance is much greater than that required from a plain bored gun; and also that a rifled gun is much more liable to burst or be rendered useless from frequent discharges, because of the force necessary to cause rotation having to be added to that which causes projection. Dr. Robinson alluded to the bronze guns of the Dardanelles, which are of three feet bore, used against our fleets not many years since, and which were made by Mohammed II., and asked whether bronze might not now be used instead of cast-iron. He suggested the probability that on experiment railway-iron might be found better than cast-iron for ordnance.

Mr. Fairbairn said the material of which guns were made was not so good as it was fifty years ago. He was present at Woolwich this week, and saw the practice of the guns there. One of them seemed properly moulded in every part; but it was found that the welding in one part was not sound, and the gas getting into the fracture operated just like a wedge, and split it as if it had been made of paper. Another was formed of steel bars, with a breech of cast-iron attached to it. The breech was entirely blown off the gun, and the bars torn asunder. It appeared to him absolutely necessary to have such a material as would not only resist the severe impulse which the discharge of the shot caused, but be perfectly solid in the mass. If they were made of parts, such as the staves of a cask, these opened, and the result was the frac-

ture of the gun. The Stirling gun was a mixture of wrought with cast-iron, and it certainly carried one-fourth or one-fifth more of common pressure, but when applied to artillery under Colonel Dundas, after a few rounds the pieces were burst. The mode of casting these large guns is also defective. They were generally cast solid, and in the cooling the metal was left exceedingly porous in the centre, and when one began to bore out the gun, one found it was not of so close a texture inside as out. Now they took the precaution of having cores in the middle, through which they sent a current of cold water to cool the inside simultaneously.

Dr. Robinson: About a century ago they cast them hollow, and it was thought a great improvement to cast them solid.

Mr. Fairbairn believed if they went about the work more carefully, they would arrive at a safer and better mode of casting than at present. If the mortars were made a foot longer, he believed, instead of sixty pounds, fifty pounds of powder would carry a shell of the same weight, and to a greater distance, and with greater accuracy. He thought, in the mortars, a great quantity of the metal was in the wrong place in a great many cases. They had the same thickness of metal at the mouth as at the breach, whereas it might taper without any danger, the pressure being less at the mouth. He explained an ingenious ball, in which there was a spiral tube, so that the ball with an ordinary gun suited all the purposes of a rifle; but he did not know whether the experiment was successful or not. Till lately guns of the ordinary calibre would stand 600 or 700 rounds before they were injured, but they always gave way at the vent. But they got into a plan of putting a tube into the vent, which made them stand 600 or 700 rounds more. Now-a-days the same guns would not stand 100 rounds; perhaps the reason was that the metal was not properly selected. He believed the subject was now before the authorities at Woolwich of what caused the explosion at Sweaborg,—and he hoped it would lead to better material, or a better selection. The iron procured by hot blast is excellent for machinery purposes; but he did not think it the best for artillery. With regard to the Turkish artillery, he was at Constantinople some years ago, and they are almost all made of a mixture of brass and tin. Mr. Mare, at Blackwall, is stated to have constructed a gun three feet in diameter—the breech of cast-iron and the tube of direction of wrought-iron.

Dr. Robinson: The bronze guns failed in a very remarkable manner. The ball rises on firing, is deflected on the gun, and if the gun is long it is again deflected, and deep holes are made in the barrel owing to the softness of the metal. Could not a thin lining of steel or wrought-iron be inserted into the tube?

Mr. Fairbairn thought it was very difficult to form any gun that differed in its parts. He would prefer to have a gun perfectly solid—of steel, if they pleased; for he had seen excellent specimens of steel manufactures from Prussia in the Great Exhibition, and well calculated for making field artillery. The artillery of the present time was much larger than it was in former times, and allowance must be made for that. The Government was endeavouring at present to get charcoal-

iron from Nova Scotia, and there were large supplies of wood and iron in the Bay of Fundy.

Mr. Lawrie proposed to have no vent at all, but to fire in the manner in which rocks are blasted, by means of galvanism. This would prevent wearing at the vent. He hoped artillery would be brought to perfection, for as weapons had improved, war had decreased in brutality; and he hoped there would be a good stand-up fight for it, in order that they might have a lasting peace.

A Member stated that some hydrostatic presses had been made of cast-iron with a case of wrought-iron, at Mr. Downie's works here, and had stood an immense pressure, but they had not as yet tried it on guns. Mr. Fairbairn asked if the gun made at Mr. Downie's had been cast in such a way as to cause an amalgamation of the cast and wrought-iron? If that were the case, he had no doubt it would secure great strength. He had a doubt, however, that there was a difference of ductility which would cause separation. It had occurred to him that they might be cast under extreme hydrostatic pressure. They had cast them at Woolwich with 19 feet of iron on the gun, but he did not as yet know the result. Mr. Sykes Ward thought a gun could not explode so readily if the powder did not impinge directly on the ball.

Dr. Scoresby stated, as the result of experiments he had made, that the quality of iron might be effectually tested by its effect in counteracting the deviation produced on a compass by a magnet placed in opposition to it.

Mr. Neilson, iron-founder, gave, as the result of his experience, that, if repeatedly heated, or heated without being subjected to severe hammering or pressure, the centre of a mass of iron was sure to become crystalline and friable.

Mr. Rennie thought the defects of the artillery of the present day were, in a great degree, to be attributed to the competition in cheapness among manufacturers.

Mr. Western suggested the appointment of a committee to collect information on the subject from practical men.

The Duke of Argyle expressed the obligation the Government would be under to such a committee for the information it might collect. Sir E. Belcher stated that, in engagements which he had witnessed, much more severe than that of Sweaborg, no accidents whatever had occurred to the ordnance. He suggested the employment of guns similar to those of the Chinese, with strong cast-iron breeches, the direction tube being a matter of little moment.—*Athenæum*, No. 1456.

MANUFACTURE OF SMALL ARMS AND ARTILLERY.

MR. WHITWORTH has taken out several patents for improvements in Small Arms and Artillery, and has placed them at the disposal of the Government, should it wish to avail itself of them. The most remarkable of his patents relates to a Rifled Cannon, which in its main features may be described as a return to the principle upon which pieces of ordnance were constructed when first introduced into modern warfare. The inner portion of the tube consists of three cast or wrought-iron longitudinal sections, forming, when put together, an accurate

nine-sided interior, with the requisite pitch for making the projectile rotate on its axis. Nicely adjusted wrought-iron bands or rings hold these sections firmly together, and distribute evenly among them the strata of the discharge. They can be tightened up into one continuous air-tight sheathing, or removed again, and the whole taken to pieces by the action of powerful screws placed at either end of the gun; each part having its dimensions accurately determined by gauge, can be replaced in case of injury, and the touch-hole will no longer, by wearing out, render the entire cannon useless. Mr. Whitworth proposes to make this new implement of warfare breech-loading, if considered desirable, and he calculates on combining in it the advantages of weight due to the present cast-iron gun, of strength, such as may be claimed for wrought-iron ordnance, of a rifle bore which presents almost insuperable difficulties by any other plan, and has not been successfully surmounted in the Lancaster; finally, of a degree of portability which would tell in a thousand different ways, and would make guns of the largest calibre available in the field. The ten-inch pistol with which he commenced his experiments in the shooting gallery was constructed on this principle, and realized all his expectations.

Mr. Whitworth has also invented for small arms, two Breech Loaders, which are remarkably ingenious, and appear to fulfil every requisite condition. One bears some resemblance to the breech used in Sharpe's American rifle, being raised up from below to form the base of the barrel; but, instead of being elevated by a lever, a screw is employed, and an ingenious application of the inclined plane on one side renders the adjustment of parts perfect, and makes any escape of the gases, when the arm is discharged, impossible. The other breech-loader bears no resemblance to any invention of the kind that we have yet seen, and will, we believe, be found upon trial to have a decided superiority over all the rest. It is a double chamber on a line with the bore of the rifle, and having a reciprocating motion from right to left, or left to right, as moved by the hand of the marksman, who thus, with a single barrel, has all the advantages of a double-barrelled gun.—Abridged from the *Times*.

MONSTER SHELLS.

A LARGE number of Shells has been supplied to the Government by the Lowmoor Iron Company for the use of the Baltic fleet in 1856. Each shell is 9 feet 6 inches in circumference; its weight is 1 ton 6 cwt. 1 qr. 7 lb.; the aperture by which it is charged, and the fusee inserted is 2⅜ inches in diameter, and the shell itself 2½ inches thick, and at the aperture 3¼ inches. Such a weight of metal requires considerable leverage to place it in the mortar, and it cannot be done without the aid of machinery, to facilitate which, the mouth of the shell is surrounded at a convenient distance by four lugs, made of wrought iron and cast into the shell, which, by these means, is placed within the mortar. The cost of each shell unfilled will be 20*l.* to 25*l.* The mortars for the discharge of these monster shells are of wrought iron, and will weigh about 35 tons each.

LAYING THE GUNS OF THE BATTERY WITHOUT EXPOSING THE MEN.

MR. BABBAGE has communicated to the *Illustrated London News*, No. 757, the following method of laying the guns of a battery without exposing the men to the fire of the enemy.

The numerous casualties, chiefly by rifle-shot, which have occurred to those employed in pointing guns at the object of attack, and also in examining their effect after their discharge, induced me to recur to means which had previously been devised for reconnoitring with security. The highest skill is required in the man who points the gun; his safety is, therefore, to be considered first.

In pointing a gun at the object to be hit, the two sights of the gun and the distant object must be brought into the same line. To do this, a man stands behind the gun and looks along that line. But if, instead of a man in that position, we put a good common looking-glass inclined at an angle with the line of direction, the coincidence of the two sights and the distant object can then be made by an observer placed in other positions.

Suppose an officer is placed in the corner of a battery where neither rifle nor round shot can reach, he may either point the gun by his eye, may employ a common opera-glass, or he may use a small telescope, which, if required, might be fixed to a post.

In laying guns by means of a telescope some little difficulty may occur from the foci for the sights and the object not being the same. This difficulty can be much diminished by placing the looking-glass at a greater distance behind the gun. In fact, with a simple inverting telescope of very low power, or with a common opera-glass, a very moderate distance will render both objects sufficiently distinct.

The angular position and elevation of the gun must be adjusted by directions from the officer to the men attending the gun. These adjustments must be contrived by screws, or other means, so as to be made by the men when screened from direct fire.

When the officer is satisfied that all the guns are well laid, he must then turn to a telescope attached vertically to the parapet. Fixed to the telescope by an arm reaching above the parapet must be another small looking-glass, having an angular motion on its horizontal axis. This telescope may consist of a single lens of from three to eight feet focus, and have attached to its eye-glass a small prism to turn the vertical rays into a horizontal direction.

The officer, having adjusted his telescope on the point he is battering, may then observe the united effect of all the guns; or he may cause them to be fired in succession, waiting between each shot until the smoke has cleared away, in order that he may judge of the precision with which each gun has been laid.

The plan of seeing round a corner by means of a small bit of looking-glass has been long known and described in books on the amusements of science. A repetition of the combination constitutes the toy by which children are surprised to find they can see through a deal board. In a different form, by means of an inclined mirror concealed within the tube, the frequenter of the theatre points his glass in one direction whilst he surveys the real object of his attraction in another. Such a telescope, when used behind a wall or a tree, becomes a safe reconnoitring telescope.

CAPTAIN GRANT'S COOKING APPARATUS FOR TROOPS.

A VERY careful and economical arrangement of Cooking Apparatus, the invention of Captain Grant, has been introduced, and is now in full operation at Aldershot Camp, having been approved and adopted by the Government. The apparatus mainly consists of a long horizontal flue, opening at the middle of its length into a chimney. This flue is built strongly of brickwork, and is covered with transverse iron plates, turned down at their ends so as to clasp the exterior of the brickwork. At each end of the flue is built a fire-place of fire-brick and fireclay, the door of which is furnished with vertical openings for the

admission of air, and with a slide for shutting off the air when necessary. The fire is also supplied with air from below, which creates so powerful a draught that any description of fuel will burn well. The iron covering plates have formed in them holes to receive cooking kettles or saucepans, which descend some distance into the flue, so that the heated gases play round a large extent of their surfaces.

Very great care and scientific skill has been shown by Captain Grant in so arranging the parts as to provide for all the circumstances to which the action of the heat is likely to give rise, such as the expansion of the metals, &c. Thus the fire-doors are made slightly narrower than the space between the brickwork enclosing them, the doors being fixed in their positions by means of studs below and above taking respectively into recesses in mortise-bars, which sustain the doors, and into the covering plates, which are over them. The intensity of the fires is regulated by means of balanced dampers suspended over pulleys placed one against each side of the chimney. These dampers are somewhat narrower than the flues, so that the draught may never, by mismanagement, be wholly stopped; and, being balanced, may be raised or lowered as occasion requires. The saucepans are fitted with handles, placed so as not to get heated, and with moveable chambers for steaming, &c. Means are provided for removing the chimney of an ordinary camp cooking-apparatus of this description, and for placing in its stead another having space in it to receive a large portable oven for baking. In this arrangement, the flues are arranged so as to bring the heated gases into close and continuous contact with the oven, and the flue above is contracted towards its lower part in order to prolong the time during which this contact continues, and thus to abstract as much of the heat as possible from the gases before they pass off.

The saving in fuel effected by the employment of this invention is very considerable. At the Aldershot Camp, where the cooking houses are all on this plan, the food for thirty thousand men is prepared with a consumption of coal amounting only to half-a-pound per day for each man, the cost being one-halfpenny per man a week.—*Mechanics' Magazine*, No. 1687.

NEW ARMY AND NAVY BED.

MESSRS. APPLETON have exhibited to the Society of Arts a new Bed or Mattress for the use of the army and navy, as well as for emigrants and travellers. This bed weighs only 4¾ lb., and when folded up is 2 feet long, and about 7 inches diameter; when spread open, it is 6 feet long, and 2 feet broad. It consists of an outer or lower covering of waterproof material and an inner lining, non-waterproof. Between the two there are corrugations, 1¾ inch broad, filled with ground or pulverized cork, which does not "mat" or "felt," preserves the body from damp, retains the heat, has sanitary and purifying qualities, and no insect can live therein. The mattress might be used, under some circumstances, for pontoons or floats, and a single one has sufficient buoyancy to support the heaviest man.

NEW STEAM GENERATOR BURNING PURE HYDROGEN.

M. Jametel, in a letter to M. Boutigny, says :—"I had ascertained, as well as yourself, that evaporation, especially that of water, might be considerably assisted by multiplying or increasing the surface in contact with the heat. I also knew that it was possible to increase the amount of heat transmitted by a metal by employing heating surfaces crossed by bars, immersed to a certain depth in fluids, exchanging their temperatures ; in fact, besides the advantage of a greater mass of heating surface, the surface of fluid in contact with the latter (plates or bars also counting as heating surfaces) would be continually renewed by the simple circulation of the fluids themselves.

"I first construct a cylindrical boiler with two hemispherical covers, the lower one immersed in a fire, the upper one in connexion with a dome, furnished with the usual appendages of steam boilers.

"This boiler is surrounded with a double case or jacket, in which the products of combustion circulate, and which products in ascending come in contact with cylindrical surfaces ending in the boiler, after having passed along the sides. The feed-water descends in a contrary direction, and comes in contact with the said bars, the heat of which increases in proportion as they approach the bottom, and being already in a state of vapour before it has arrived at this point, it becomes surcharged with heat, and yields a completely dry steam, which should then and there be taken. The products of combustion continuing their passage come in contact with metallic wire-cloth, which removes the last particles of heat from them.

"The whole, boiler and casing, is placed in a furnace of masonry, but a space is left in which the air which feeds the combustion is heated as it comes in contact with the sides of the casing.

"With respect to the combustion I should tell you that the hydrogen comes in from underneath, and into the centre of a circular case furnished on the inside with wire-cloth, the upper cloth carrying a layer of amianthus, on the surface of which the hydrogen burns, the necessary air previously heated flowing in laterally thereto."—Translated from the *Moniteur Industriel.*

BIDEN'S PATENT IMPROVEMENTS IN MARINE STEAM-ENGINES.

The increased extent to which high-pressure steam is now coming into use renders it necessary that all accessory contrivances for improving the effectiveness and economy of Engines should be made available. At present there is excessive waste in our modes of condensation, and boilers are rapidly destroyed by the injurious action of salt water upon them.

It is well known, and has been frequently shown by experiment, that steam is readily condensed by being passed through a metallic conduit immersed in a constant stream of cold water. Symington and others availed themselves of this mode of condensation. Mr. Biden contemplates in his patent the adaptation of this system to high-pressure engines, so as to return the condensed steam, as water, at nearly boiling temperature, into a reservoir whence it is to be pumped back into the

boiler. The temperature of this returned water may, of course, be regulated by the length and size of the pipe or conduit through which it is passed, these being determined also by the pressure at which the steam leaves the cylinders.

The great advantages resulting from this arrangement are easily seen. The duration of the boilers employed in connexion with it would be much increased, and the expenditure of fuel would be necessarily diminished.

The patentee provides two safety or escape-valves: one to carry the steam which passes off when the engine is stopped to the condenser—the other, which is a little more weighted, to ensure safety should the first, by neglect or accident, get out of order.—*Mechanics' Magazine*, No. 1657.

NOVEL DESIGN IN NAVAL ARCHITECTURE.

The difficulties which have occurred in the prosecution of the War with Russia, from the deep draught of our line-of-battle ships may, perhaps, secure attention to the following design for a great raft, propelled by an immense steam power, which has occupied the thoughts of its projector, Mr. Daft, a civil engineer, for a period of thirteen years. As will be gathered from the details, he contemplates a complete revolution in the existing system of naval architecture. To many the scheme may appear utterly wild and impracticable, but some may, nevertheless, trace in it materials for useful reflection. It is proposed that the raft should be composed of 300 pontoon-shaped iron boats, nearly all 100 feet long by 10 feet wide and 7 feet deep, having semicircular bottoms and sides, and flanged on the edges or gunwales. With fifteen of these placed longitudinally, the length of the raft would be 1500 feet, and 20 in breadth, with 5 feet spans between each, would give a width of 300 feet. Thus the deck area would be little short of ten acres. The pontoon boats it is proposed to brace together by diagonal tie-bars, while the deck would be formed of timber six inches thick, firmly bolted to the flanges, and having hatchways into each of the boats, which would thus furnish the accommodation and stowage required for passengers and goods. Bulwarks are contemplated, 12 feet 6 inches high, and consisting of hollow iron stanchions, 33 feet 4 inches apart from each other, with iron compartments between, made to open from the top on centres. The whole mass would thus be braced together as if it were one huge solid substance 1500 feet long, 300 feet wide, and 20 feet thick. It is proposed by the bold projector of this new leviathan to propel her by twenty-two steam engines of at least 200 horse-power each, eleven on each side of the raft, with paddles and screws affixed alternately. Into the arrangements for mooring, for saloon space, commander's quarters, an observatory, &c., it is not necessary to enter; but the calculation is, that the raft will carry a freight of 20,000 tons, though perfectly safe and steady without, obtain a speed of fifteen knots an hour, draw only 3 feet 6 inches of water, and give a surface sufficient to act as a floating breakwater in the roughest sea. The projector contends that it will be impossible to founder such a struc-

ture; that, in case of running ashore, the boats grounded can readily be drawn off by the power of the engines; and that the principle of the design involving the repetition of so many given parts, as in the architecture of the Crystal Palace, these can be let out to different contractors, and the whole got together with the greatest rapidity and ease.—*Times.*

NOVEL STEAMER.

A VESSEL, with several striking points of novelty, has been built, to ply on the Clyde. The engineer is Mr. George Mills. The vessel, instead of being built solid, and with a bow and a stern (each different), is divided into two parts, perpendicularly on a line with the keel, from end to end, while the ends themselves are formed equally the same, so as to admit of her sailing with either first. The two portions are placed apart and parallel to each other, and the recess formed betwixt them will then be a rectangular space for the main paddle-wheel to work in. The fabric will then present a broad platform, the hulls at each side being available for carrying the engines, boilers, &c., while the four parts may contain cabins. On the platform, which has been formed by dividing the vessel into the shape described, cabins or saloons may be placed with passages round them, and having plates of glass on each side, to admit of scenery being viewed to great perfection. These again may have their roofs decked, which would make them available for promenades. In order to obtain manœuvring power, the vessel has a small paddle-wheel placed at each end, the immersed float of which stands vertically to the passing fluid, and thus only presents its edge as a resistance to the way of the vessel, the other floats and portions of the wheel being above the surface of the water. When the vessel is approaching a pier, or in any intricate or crooked navigation, the paddles will be used for the purpose of manœuvring her; and this can be done so as to cause her to go either to one side or the other, or to go broadside on, or to whirl round in her own length.—*Liverpool Standard.*

IRON MASTS AND YARDS.

MESSRS. CATO, MILLER, and Co., of Liverpool, have constructed an Iron Yard of the following extraordinary dimensions:—

Length	112 feet.
Diameter at slings	2 feet 4 inches.
Do. yardarms	1 foot 2 inches.

This mainyard, the largest ever made, and weighing from seven to eight tons, is for the new ship *Schomberg*, belonging to Messrs. James Baines and Co.'s Black Ball line of Australian clippers under the patent of the inventor, Mr. J. Clare. A wooden yard of the same size would weigh from eleven to twelve tons; and when we take into account the difference between the iron and wood yard (the former is hollow, of course), we think it of sufficient importance to the shipping interest to direct especial attention to this invention. The weight of spars is a consideration in the outfit of a vessel, and when a material can be found lighter than wood, and that material cheaper, we should think it would

be to the interest of shipowners to countenance the substitute. The workmanship of the mainyard of the *Schomberg* is beautiful.—*Liverpool Telegraph*, Sept. 22.

SCREW PROPULSION.

A PAPER has been read to the Institution of Civil Engineers, "On the Application of the Screw Propeller to the Larger Class of Sailing Ships, for Long Voyages," by Mr. R. A. Robinson. The introduction of Screw Propulsion in 1839 by Mr. F. P. Smith, and the success he attained with the *Archimedes*, directed attention to that system for commercial vessels; the *Great Britain* was an early instance of the application, and then followed the fleet of screw steamers established by Mr. Laming, for the trade between London and the ports of Holland. Thence the progress was so rapid, that at the beginning of 1854 above two hundred commercial screw ships were registered in the United Kingdom. Meanwhile, many attempts have been made for using large powerful screw ships on the long sea routes to India and Australia, but uniformly without success. The author's object was to investigate the causes of this failure, and to suggest the means of attaining success.

At the late meeting of the British Association, in a paper "On the Effects of Screw Propellers when moved at different Velocities and Depths," Mr. G. Rennie stated, from experiments which had been made under his observation, it was desirable that the screws of vessels should be of small dimensions, light, and of rapid motion, and that their effect would be increased by their being as deeply immersed as possible. He also recommended the disc screw. Several members questioned the effect attributed in the paper to deep immersion.

NEW MODE OF PROPELLING STEAMERS.

DAVIES'S Patent Railway Floats for Propelling Vessels consist of a series of float-boards inside a chamber or recess let up into the bottom of the vessel—a sort of double-keel one-third of the way along from the stern. These float-boards are carried on an endless railway, in two horizontal lines inside the chamber. When propelling they are vertical, and they return above horizontally to renew their action, and then offer but little resistance to the water. Thus half the number are always propelling. The float-boards, in changing their position, "feather" without jerk or blow, the upper edge going first. As soon as a float-board descends, it acts upon all the water confined in the chamber, and, as it cannot escape by the sides, or above the float-boards, it must necessarily all be carried through the opening at the stern, against the heavy pressure of water from without, or carry the vessel rapidly onward. Competent engineers are said to have admitted that this "confining of the water will give to the action of the float-boards the same effectiveness as if they pressed against a dead wall."—*Builder*, No. 625.

IMPROVEMENTS IN PROPELLING VESSELS.

MR. C. DE BERGUE, of Dowgate-hill, has secured a patent for a New Propeller. It consists of a rectangular box, open at both ends, fixed

laterally on the sides of the vessel, in the place of the ordinary paddle-box, but completely under water. A disc of iron, or other metal, fits closely into this box, and is coupled to the crank on the main shaft of the engine by a connecting-rod. This disc acts as a plunger, and when in action the end towards the bows first reaches the bottom of the box; the hinder end then coming down rapidly, ejecting the water sternwards with great force, somewhat on the principle of the common bellows, propels the vessel forwards. Working under water, it is out of reach of gun-shot, and is therefore as safe in that respect as the screw.—*Builder*, No. 625.

GRIFFITHS'S PATENT SCREW PROPELLER.

At the Vauxhall Foundry, Liverpool, has been executed the largest brass casting yet made at that place, namely, Griffiths's Patent Screw Propeller (for the United States war frigate, the *Princeton*), of 16 feet 6 inches diameter, weighing, with its spare blade, about 8 tons. This propeller, as well as two others, constructed by Mr. Robert Daglish, jun., St. Helens, for the royal navy, embrace all the recent improvements introduced by Mr. Griffiths, which are—Increased speed relative to the power employed. The entire absence of the destructive and unpleasant vibration which invariably attends screw vessels with the ordinary propeller. The absence of this, in the case of Griffiths's screw propeller arises from its peculiar form, the blades being wide at the root and tapering towards the extremity, or exactly the reverse of all other propellers. It offers no obstruction to the vessel when under canvas, nor does it in the least degree affect the steering qualities of the vessel. All that is required is simply to fix or stop the engine with the propeller in a vertical position.

Several plans have already been tried to obviate the drag of the screw when not used, and the most effective and successful is the one adopted in the royal navy, which consists in lifting the screw out of the water; but this plan, in the merchant-service, is attended with several disadvantages. 1st. The well-hole, for lowering and lifting the screw, must be made through the chief cabin; 2nd, besides adding considerably to the expense of ship and machinery, it is also attended with much trouble and labour to hoist and lower the screw, and to ship or unship it to or from the connecting machinery, which cannot be made so firm and solid as when a fixed screw is used.

It is now generally admitted that a screw vessel, well rigged, and with a favourable breeze, might make her passage nearly as soon, without using her machinery, as the best sailing ship; and this was shown by the *Great Britain* on her voyage to Australia, when she made seventeen knots per hour under canvas alone, with the screw so immersed.

Another important advantage offered is the facility of replacing a blade which may get broken through some accident. It is not an unusual occurrence for a screw-ship while at sea to lose one or two blades. To provide for these casualties, and also to enable the engineers to fix the pitch of the screw to suit the vessel and engines, this propeller is constructed with the blades inserted into a large centre boss, secured in its position and so arranged that you may either alter the pitch of the

screw or permit the insertion of a fresh blade into it without requiring the docking of the vessel.—Abridged from the *Liverpool Times.*

CLIFFORD'S PATENT METHOD OF LOWERING SHIPS' BOATS.

Mr. Clifford, of Inner Temple-lane, has patented certain improvements in Apparatus for Lowering Boats evenly, for preventing their filling with water, and for releasing them effectually from the vessel to which they belong in times of emergency.

In this invention, a barrel is placed under one of the seats, having two holes therein. Three ropes are employed; one of which, being passed through the barrel and firmly secured therein, is wound round it. The other two ropes are fixed to the ordinary davits or apparatus at the ship's side; they pass respectively through two blocks (each having three sheaves, which may or may not rotate on axes), and then enter one hole in the barrel in opposite directions; they are otherwise left unfastened. The two blocks are fixed to diagonal ropes, which are inside, fast on either side of the boat. By this arrangement, when the first rope is pulled the barrel rotates and winds up the other two ropes to any required elevation. The first rope is then made fast to hitch-pins, or otherwise, in the boat. The lowering is effected by paying off the first-mentioned rope, thus allowing the barrel to rotate; and as soon as the boat has descended and moved to a distance equal to the length of the two ropes, they will be drawn out of the holes and through the blocks, and the boat will be free.

BUOYS AND BEACONS.

In a discussion, at the Institution of Civil Engineers, on Mr. Herbert's paper "On the Construction of Buoys, Beacons, and other Stationary Floating Bodies," it was generally admitted, that most favourable reports had been received relative to the Buoys; they were moored in extremely exposed situations, where they had proved their superiority, by being always visible, and deviating but slightly from the perpendicular, at times when buoys of the old form were almost entirely submerged, and were only visible at intervals, in a horizontal position, in the trough of the sea. There was no reason why a larger class of Beacons on the same principle should not be equally successful, and it was probable that it might be extended to supporting floating lights. The latter, however, demanded experiment.

STEAM FLOATING-BATTERIES.

The inapplicability of our large ships of war for the attack of the Russian stone fortresses and strongly-fortified harbours, has led to the construction of a large number of Floating-Batteries. These vessels are built from one model, and are pierced for ten or twelve guns; except two batteries, the *Glatton* and the *Trusty*, which are pierced for sixteen guns.

	Feet.	Inches.
Length between the perpendiculars	172	6
Breadth, extreme	43	8
Depth in hold	14	7
Draught	7	9
Tonnage	1469 tons.	

The two decks (the lower one to be the fighting deck) are of 9-inch oak, resting on 10½ in. by 10½ in. beams, placed 1 ft. 9 in. apart from centre to centre, and supported in the middle by stancheons of iron hinged at the top, so as to be struck or hung up when in action. The frames, iron plates, and planking of the sides, form a solid mass 2 feet thick; the iron plates outside being 4 in. thick, planed on their edges, placed close together, and bolted to the woodwork with 1¼ in. bolts. The port-holes are 3 ft. 4 in. by 2 ft. 10 in.

The engines of these batteries are of 150-horse power, non-condensing, and have four tubular boilers with two furnaces in each; the boilers being of a cylindrical form, with flat ends, and capable of working up to a very high pressure. These batteries have been fitted with a screw, six feet diameter, in the usual place; but other two, one on each side, will now be added, to give more propelling power; the shallow draught and small area of the screw, in consequence of the necessarily small diameter, rendering this addition necessary: for, with a pressure of 60lb. to the square inch, and the engines making 130 revolutions per minute, the speed attained was but a little over three knots per hour.—Abridged from the *Illustrated London News*, No. 763.

THE ERICSSON AS A STEAMER.

THE *Ericsson*, now converted into a steamship of improved design, made her trial trip down the Bay on May 12. Captain Ericcson claims to have made a very important improvement by his new condenser. The saving is great in fuel, in the wear of the boiler, and the labour of cleansing it, through the use of fresh water in lieu of salt. By the new plan, the boilers of the *Ericsson* are charged with fresh water; and as there is no waste, she may carry the same out from New York to Havre and return without diminution other than what might result from accidental leakage. In addition, she has apparatus for distilling 1000 gallons of fresh water from salt a day, so that the great bulk of the water-tanks is saved for freight. Altogether, as a steamship, she comes near to the caloric standard of cheapness of power and economy in space. The room occupied by the machinery and boilers is unusually small, and the consumption of fuel greatly reduced from the old standard. It is stated that her furnaces cannot consume over thirty tons a day, and it is expected the Atlantic voyage will be made on a ton an hour. The speed of the ship on her trial trip was about twelve miles an hour, with an alleged consumption of fuel not exceeding three-fourths of this quantity.

The underwriters rate this steamship the best and strongest-built vessel, without exception, in the United States. She is provided with four large quarter-boats, all slung, and two deck-boats, all of them Francis's life-boats. In addition, she carries a life-car, mortar, and lines, which, in case of her being driven upon the coast, would enable her at once to communicate with the shore and land her passengers in safety.—*New York Paper*.

In the same journal appears the following interesting *résumé* of the previous fortunes of the *Ericsson*, giving a clearer account than has yet been furnished of the experiment of hot-air as a motive power with

which she has been connected. At her first trial, the ship accomplished about nine revolutions of her wheels a minute and a speed of about seven miles an hour. Her cylinders were so large, being fourteen feet in diameter, that the bottoms, to which the fires of the furnace were directly applied, were rendered insecure through constant expansion and contraction. This difficulty it was found could not be easily remedied, when the plan was adopted of running the ship on the high-pressure principle, and by this means very much reducing the size of the cylinders, bringing them down to about six feet. This operation was long in being accomplished, and was attended with very heavy expenses; so that the Company formed to test this new motive power had almost altogether withdrawn. Such was the state of things when the ship, in May or June last, made her first trip with the new machinery; and when, in returning to her dock after what Captain Ericsson deemed a most successful trial, she was struck by that fatal flaw which carried her to the bottom. The internal finishing of the ship, which was most sumptuous, was ruined by this accident. The river was then swollen by a heavy rain, and turbid in the extreme. The mud of its banks, held in solution by the disturbed currents, settled in every chink and cranny, penetrated and encrusted every part of the cabins, saloons, state-rooms, and engine, adding to the latter a rust even worse than the filth, and necessitating its entire removal. The accident, though happening at home, was nevertheless a complete shipwreck. The ship was in fact reduced to a mere hulk, with everything moveable in ruins, and everything fixed requiring renovation, the entire machinery included.

The vessel was, after weary exertions, finally got into dock. It was then that somebody's money must repair damages, and be the means of saving what could be saved from the wreck. No one had sufficient confidence in the resuscitation of the now unlucky enterprise to advance funds to carry it out. The consequence was, that the beaten track had to be resorted to, and the vessel was converted into a steamship. Such is in brief the story of the *Ericsson.*

THE NEW AMERICAN STEAMSHIP, "C. VANDERBILT."

THIS colossal steam-ship has been launched from the building-yard of J. Simonson, in Green Point, New York. She is the first of a class heretofore deemed almost apocryphal, and at least quite impracticable, by builders in general. Her dimensions and power are much greater in proportion to those of the *Atlantic* and the *Africa* than are the latter to the *Great Western* or the *Sirius*, which were substantially the pioneers of ocean steam navigation.

The cost of the *C. Vanderbilt* will be about 700,000 dollars. The extreme length of the hull is 335 feet, and the length at the water line is 328 feet; the breadth of beam is 49 feet, the depth of hold 33 feet. She is of 5100 tons burden, carpenter's computation, or about 4000 tons register. The water-lines are nearly straight, and the centre of displacement amidships—indeed, the centre of the ship, the centre of weight, and the centre of buoyancy—fall within a distance of 8 feet fore and aft. The main-deck is of great capacity, even in comparison with

the size of the ship: this is owing to the fulness of her lines. Her lower decks, of which there are two, besides the boiler deck, are of the same character. The floor is nearly flat, and is formed entirely of solid white oak, each timber being 15 by 21 inches, bolted together lengthwise of the ship with one and a quarter inch bolts, seven feet long; sixty tons of these bolts are used. The frame-timbers, which are principally of white oak, are placed unusually close together, and are strapped diagonally by 94 tons of wrought-iron straps, which are bolted wherever they cross each other. The planking is of oak, six inches thick. The hull weighs 2300 tons. Her engines will be supplied by Messrs. Secor and Braisted, of the Allaire Works, with two marine steam engines. The cylinders will be 90 inches in diameter, and the stroke of the piston will be 12 feet. The side pipes will be 28 inches in diameter. The horse power is estimated at 1700. The engine will be finished in the most complete manner, and from its position in the ship will be an ornament to it. Its workings may be observed like the engines on North River steamboats. The cylinders will weigh 19 tons each. The crossheads which support the shafts, will weigh five tons each. The shaft will be 25 inches in diameter, and all the minor pieces are elegantly finished, and fitted with the utmost nicety and exactness. The wheels will be of wrought-iron, 42 feet in diameter, which is larger than any yet built. The face of the paddle will be 11 feet long: there will be three flanges to each wheel, weighing 7 tons a piece. There will be four tubular boilers—28 feet in length, 13 feet in width, and 14 feet high: they will be fired from the side. The two engines will be placed amidships, and two of the boilers fore and aft, facing each other about 15 feet apart. From the boilers, the steam-chests will rise 14 feet. The smoke-pipes, one to each pair of boilers, will be 11 feet in diameter. The steam-ship will be supplied with two masts, upon each of which will be placed two yards. There is no bowsprit to the vessel, and apparently but little reliance will be placed upon her sails. —Abridged from the *New York Courier and Inquirer*.

THE SCREW STEAMER "AZOFF."

THIS vessel combines many points of excellence which, so far as we are aware, have never before been attained in so complete and efficient a manner. The *Azoff* is of 800 tons, builder's measurement; she is built under Lloyd's new rules for iron ships; is classed A 1 for twelve years, the longest period for which iron ships are classed; and is believed to be the strongest steam-vessel yet constructed. Not only are the scantlings very heavy, but the distribution of the materials is so managed as to secure the maximum of strength when the vessel is subjected to a longitudinal strain—the only species of strain from which iron vessels are found to suffer. The model of the vessel is a very fine one, being sharp at the ends and with a considerable rise of floor, which prevents the ship from rolling in the way usual in screw vessels. Notwithstanding the fineness of the model, however, the vessel has large carrying capacity, as will be obvious from the fact that she has carried out to the Crimea nearly 400 navvies and about 600 tons of cargo, besides nearly 300 tons of coals and 8000 gallons of water. This large carrying power is the result chiefly of the smallness of the space occupied by

the engine, which, although capable of propelling the vessel at the rate of 13 or 14 miles an hour, does not, exclusively of the boilers, fill a space of more than 20 measurement tons in the vessel. The vessel and her machinery have been designed and constructed by Mr. Bourne,* civil engineer of Glasgow and Greenock; and the whole combination seems to realize the desire so general among shipowners, of uniting a high rate of speed and a fine form of vessel with large carrying capacity. The fine model of the vessel enables her to be propelled easily through the water, and the steam is supplied to the engine during only a small portion of the stroke, leaving the residue of the stroke to be completed by the expanding steam, by which arrangement steam and therefore fuel are saved to a very important extent. This expedient of economy is well known and largely practised in Cornwall, in the case of the pumping engines for the mines; but has been hitherto availed of in steam navigation only to a very small extent; whilst the main secret of the superior economy of fuel attained in the *Azoff* lies in the more perfect and extensive application of this principle than has heretofore been usual in steam-vessels; and next are the small dimensions of the machinery, which prevents any important loss of heat by radiation, or of steam by leakage through the piston. The compactness and simplicity of the machinery in the *Azoff* exceed that of any other vessel: there are few parts to be looked after or to go wrong; and when to these important qualities are added the smallness of her consumption of fuel we think there is fair reason to conclude that she is yet without a rival. The *Azoff* left the Thames in the autumn with a number of navigators for the completion of the railway in the Crimea.—*Times.*

NEW IRON MORTAR BOATS.

An Iron Mortar Vessel has been so constructed by Mr. John Laird, that when she has mortar, shell, crew, and every necessary appliance on board, she will only draw three feet of water. She will present very little bulk above the surface; and as she will be painted sea-green, it will be impossible for the enemy to distinguish her from their batteries, even when within range of their guns, except by the occasional puffs of smoke from each shell. She is of 100 tons measurement, and is made of the best iron plates, manufactured at the Mersey forge. The expedition with which she was constructed is, we believe, unprecedented. The order was received by Mr. Laird on the 23rd of October; the keel was laid down on the 25th of the same month; and on the 13th of November, just three weeks from the day of the order being received, she was launched in the River Mersey, complete, with mortar-bed, masts, rigging, anchors, cables, sails, shell-room, accommodation for crew, &c. The vessel is strongly built of iron, with wooden decks, and the complicated nature of the work would have precluded the possibility of her completion in this short time had not Mr. Laird provided relays of men working night and day. This is stated to be the first English mortar boat built of iron.

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* Author of some valuable works on the *Steam Engine and Steam Navigation.*

IMMENSE MARINE FORGINGS.

In the *Greenock Mail* is described a portion of the machinery now constructing by Messrs. Fulton and Neilson, Lancefield, for the stupendous steamer of 10,000 tons burthen, building by Mr. Scott Russell, at Milwall, and described in the *Year-Book of Facts*, 1855, pp. 37, 38, 61, 62. The following are some of the forgings:—

1 Intermediate shaft, 21½ feet long, 26-inch diameter.

2 Paddle shafts, 37½ feet long, 24¾-inch diameter.

2 Cranks, 7 feet 'tween centres, and 21-inch thick.

Propelling shaft, 47 feet long, and 24¾-inch diameter.

3 Friction straps, 10 feet inside diameter, 14½ inches thick; also columns, covers, &c.

The forging of the intermediate shaft occupied upwards of six months. It is 29 tons in weight—the largest ever made—and certainly one of the finest pieces of forge-work in the world. The forging of each of the two paddle-shafts will occupy two months; and, when completed, they will be about 30 tons weight each.

Of the two cranks, when polished and ready for fitting up on board, the nett weight was 7 tons 4 cwt. each. One of these cranks was sent to the Paris Exhibition by Mr. Scott Russell, where it excited considerable attention.

The propeller shaft is the heaviest piece of forged iron in the world. It is nearly 35 tons in weight. The peculiar feature of this shaft is its great length. It will be connected with no less than nine other shafts, each 25 feet in length, and 24¾ inches in diameter. When connected, the extreme length of the whole shaft will be about 275 feet; and, exclusive of couplings, the gross weight will be little short of 290 tons.

The friction straps each, when finished, will weigh about 10 tons.

As for the vessel, so much has been written about her already, that there is now little left to add. We may mention, however, that the jolly boats, eight in number, will all be small screw steamers, and will be raised and lowered by water power; and the vessel herself will be steered by a small engine of several horses power. She is expected to be launched in about twelve months, or in February, 1857.

PREVENTION OF SMOKE IN STEAM-VESSELS.

An experiment has been tried at Portsmouth, on board the royal steam-tender *Elfin*, with Mr. Prideaux's Furnace Valves for the Prevention of Smoke. Not only was the smoke effectually got rid of, and with West Hartley (!) coals, but the steam was kept up in the boilers at full pressure, after one furnace fire out of four was extinguished; showing that the advantages conferred by these valves in preventing smoke and reducing the temperature of the engine-room are obtained without any diminution of the steam-generating power of the furnaces. Upon Mr. Prideaux's valve-doors being removed, and the ordinary doors substituted, the thermometer, which had previously stood at 66 degrees, rose to 96; exemplifying what must certainly be regarded as one of the features of this invention—viz., that during its use the exterior of the fire furnace-door always remains cool, no matter to what extent the firing may be pushed.

NEW STEAM FIRE-ENGINE FOR THE RIVER THAMES.

THE very important services which have, on many occasions, been rendered by the steam floating fire-engine, at water-side fires, determined the Committee of Management of the London Fire Establishment to provide a second and more powerful machine of that description, and for the future to abolish the use of manual labour in the floating engines. The boat is of iron, about 130 feet long, and was built by Mr. Mare, at Blackwall. It is fitted with two horizontal double-acting brass pumps, 10 inches diameter, worked by two direct steam cylinders, 14 inches diameter, and 18 inches stroke. Each pump, with its steam-engine, is mounted upon a strong iron frame, and placed one on the larboard, the other on the starboard, side of the vessel, about midships. Each steam cylinder is provided with a tubular boiler. The air-vessels are of copper, of the balloon form, and of great capacity. They are placed immediately over the pumps, and deliver their water into a six-inch horizontal main, which connects them together; and from which four 4-inch pipes rise through the deck, terminating in screwed elbows, for the attachment of the leather hose. The main can readily be shut off from either engine, and each one of the service-pipes can at any time be opened or closed at pleasure. The leather hose, of which a very large quantity is provided, is 3½ inches in diameter, and has been tested to 100 lbs. upon the inch. It is wound upon two large reels, placed before and abaft the engines. The pump-valves consist of a large brass grating, upon which is placed a butterfly valve of thick vulcanized caoutchouc. The valve is not loaded, but has a perforated guard-plate above to prevent it from opening too far. By this beautiful arrangement the intolerable noise which accompanied the action of the large metallic valves in the former engine has been got rid of. The power of the engines collectively is 80 horse-power, and may be worked up to 100 horse-power. It is expected they will throw four jets of water, 1½ inches in diameter, or 10 jets of 1 inch each to the usual heights! As the boat, when fully equipped, will draw but little more than 3 feet of water, neither screw nor paddle-wheels could be used as propellers; recourse has therefore been had to a somewhat less efficient but more convenient agent—the jets. For this purpose a centrifugal wheel, or pump, upon Mr. Appold's plan, has been placed behind the engines, and motion given to it by two large driving-wheels; these driving-wheels, when disconnected from the propeller, acting as fly-wheels to the steam-engines, carrying them over the dead centres. The piston-rod of the pump is attached to the piston-rod of the steam-engine by a screw coupling, which is readily connected or disengaged. The centrifugal pump is 3 feet 2 inches diameter by 9½ inches wide; and the outlet of each of the two propelling jets is 12 inches in diameter, with the power of reducing them as may be desired. The numerous contrivances to guard against accidents, and to make each part independent of the other in the event of injury, as well as the compact and judicious arrangement of the whole, display much ingenuity and forethought on the part of the designer, Mr. James Shand, of the firm of Shand and Mason, by whom the whole of the engine work has been

executed. The propelling apparatus has been constructed agreeably to the plans of Mr. J. G. Appold.—*Mechanics' Magazine.*

STEAM BOILER SAFETY VALVES.

A PAPER has been read to the Institution of Civil Engineers, "On the Application of Volute Springs to the Safety Valves of Locomotive and other Boilers," by Mr. J. Baillie, communicated by Mr. R. Stephenson, M.P. In order to commence the discussion on the paper, a "Description of an improved form of Safety Valve for Steam Boilers," by Mr. J. Fenton, M.I., was read by the Secretary. The object of this valve is the prevention of accidents, arising from the liability of the ordinary mushroom-shaped safety valves to stick fast; this is effected by making the valve spherical, with a hemispherical seat and a hemispherical cup bearing upon the ball valve; this cup is connected to the valve lever by a spherical joint; all the other joints of the lever and attachments being also on the ball and socket construction, so that all are free to move in any direction and no sticking of any part is possible. An illustration was given of the adaptation of the volute springs to hydraulic safety valves for equalizing the pressure on watermains, and obviating the injurious effects of the concussion caused by the oscillation of the column of water. This system, which has been introduced by Mr. Croker, for the Amsterdam Water Works, is easily adjusted to a head of 170 feet, representing a pressure of 39.2 lbs. per square inch, or a total load of 1970 lbs. on the valve; it has been in use for six months, and might be perfectly relied upon. The arrangement is very simple, consisting merely of a vertical branch of 8 inches diameter springing from the horizontal main-pipe of 6 inches diameter. On the top of the branch pipe is fixed a valve and set of gun metal, so arranged, that upon the lugs are fixed the wrought-iron bolts holding the cross-bar, between the under-side of which and the top of the valve is placed a volute spring of about 2½ tons pressure; the exact pressure is regulated by adjusting bolts provided with stop-nuts, and the apparatus can be accommodated to the required head with great facility and precision.

MOTIVE POWER OF ELECTRICITY.

Mr. G. E. DERING, of Lockley, Herts, has patented a mode of obtaining Motive Power from Electricity. The arrangement consists of a flat surface, composed of a series of electro-magnets, on which is made to rock or roll by their galvanic action, a cylinder, which either constitutes a keeper or armature for all the magnets, or carries, or has suspended to it, a number of armatures corresponding with the electro-magnets. The object of the arrangement is, that by a succession of small pulls, one long stroke may be obtained, and thus the full power of every magnet secured without the loss hitherto sustained in most arrangements for producing electro-motive power.—*Builder*, No. 628.

PATENT ENDLESS RAILWAY.

MR. BOYDELL, of the firm of Boydell and Glasier, Camden Works, London, has brought forward an invention which excited considerable

attention at the recent Carlisle Meeting of the Royal Agricultural Society of England. It consists in attaching to the wheels of a vehicle a number of shoes or sleepers, on which are fixed short lengths of iron rail, so that as the vehicle advances, these portions of rail are successively brought beneath the wheel, and thus virtually form an endless railway on which the carriage runs; the connexion between the wheel and each shoe or sleeper being of such a character that the action is the same as if the two were altogether independent of each other for the time that the wheel is traversing the rail. The length of the shoes or sleepers of course depends upon the size of the wheel, and the number of them is generally about five to each wheel.

It is plain, that vehicles fitted with this Endless Railway can only be used where slow motion alone is requisite; for were the velocity acquired very considerable, the centrifugal force applied to the parts of the railway would produce certain derangement. This circumstance, however, does not affect the utility of the invention as applied to agricultural purposes, or to many other operations in which a greater rate than four or five miles an hour is not requisite.

Mr. Boydell's attention has not, it should be stated, been confined to the simple principle of connecting to the carriage-wheel an endless railway, but rather to the method of applying this principle so as to obtain a practicable and efficient arrangement of the parts.

AERIAL RAILWAY.

The Select Committee of the Royal Arsenal at Woolwich have witnessed the erection of a novel machine, introduced by the inventor, M. Balan, a working French engineer, who has obtained for it a patent from the British Government. The apparatus bears the title of an Aerial Railway, and propels cars or waggons by their own weight on inclined wire ropes. These ropes are firmly attached at the extremities; and at the ends where the materials or goods are to be unloaded they are kept apart by a lever, the length of which varies according to the inclination required. The centre of this lever is attached to an upright post by a bolt. When the lever is horizontal the ropes are horizontal, and when one end of the lever is depressed the ropes will be inclined in a reverse way, and the cars travelling on rollers will go in opposite directions. For earthworks, such as cuttings, embankments, quarries, &c., this apparatus will be found useful, as it requires few hands to work it; the weight of the load depressing the rope, so that the car travels without assistance to the lever, where it is unloaded; and the other rope being raised, the car slides to its loading place. It may be advantageously used for crossing rivers, where bridges would interfere with the navigation, and in any place where the distance does not exceed 400 yards to convey either goods or persons. Beyond that distance the rope must be supported by uprights placed according to the undulation of the ground. To enable the cars to pass the supports, a framework is fixed in front of each; on this framework is laid a moveable frame, with ropes attached, so as to pass over pulleys set in the stationary frame, the other ends of the ropes having counterbalancing weights. The moveable frame is laid near the ground, and is maintained in that position by a

trigger, so that when the car arrives it touches the trigger, the moveable frame is released, and drawn up by the counterbalancing weights; thereby giving the rope a greater inclination, and allowing the cars to pass over the upright, and giving it a sufficient impetus to reach the next frame, where the same operation takes place. It is likewise adapted for the purpose of an electric telegraph, copper wires being placed inside the ropes in the same way as in the submarine telegraph.

ALL THE RAILWAYS IN THE WORLD.

THE number of miles of Railway in operation upon the surface of the globe is 40,070; of which 16,964 miles are in the eastern, and 23,106 in the western hemisphere; and which are distributed as follows:— In Great Britain, 7774 miles; in Germany, 5340 miles; in France, 2569 miles; in Belgium, 873 miles; in Russia, 422 miles; in Sweden, 75 miles; in Norway, 42 miles; in Italy, 170 miles; in Spain, 60 miles; in Africa, 25 miles; in India, 100 miles; in the United States, 21,310 miles; in the British Provinces, 1327 miles; in the Island of Cuba, 359 miles; in Panama, 50 miles; and South America, 60 miles.

The longest railway in the world is the Illinois Central, which, with its branches, is 731 miles in length, and was constructed at a cost of 15,000,000 dollars.

The number of miles of railway in the United States exceeds that in the rest of the world altogether by 2550 miles. The number of railways completed in the United States is 274; the number partially completed 63; and the number in course of construction 107: the number of miles now in operation is 21,310, which have been completed at a cost of 621,316,103 dollars. The number of miles in course of construction is 16,975. The State of Massachusetts has one mile of railway to each seven square miles of its geographical surface: Essex county, in this State, with a geographical surface of 400 square miles, has 159 miles of railway facility, which is a ratio of one mile of railway to each three square miles of its geographical surface. The permanent way of the American railways, however, is said to be of a very flimsy character compared with that of England.—*Builder*, No. 630.

THE PANAMA RAILWAY.

THIS line, connecting the Atlantic and Pacific Oceans, is now actually completed, and the trains are running through from sea to sea! It extends from Navy Bay, on the Atlantic, to the Bay of Panama, on the Pacific; its entire length being less than forty-nine miles. Its gauge is five feet; its grades are easy, the highest for a short distance near the summit being sixty feet to the mile on the Pacific, and fifty-three feet to the mile on the Atlantic slope, the summit being only 250 feet above the level of the sea. Some of the bridges are of iron, and it is intended to replace all the wooden structures with that material. The neutrality of the isthmus it traverses is guaranteed by the Government of the United States by special treaty with New Granada; and also by Great Britain and the United States by the Bulwer treaty. It thus becomes the highway of nations. The amount expended on the road to this date is about six millions of dollars (1,200,000*l.*). It is

estimated that one million of dollars more will replace the wooden bridges with iron, and finish and fully equip the road for expected increase of traffic, making the entire cost 1,400,000*l.* sterling, or seven millions of dollars. This has been accomplished by the enterprise of our Transatlantic brethren, at an inconsiderable cost in view of its importance, a work which many pronounced an impracticability, and all deemed a hazardous undertaking.—*Builder*, No. 627.

PREVENTION OF ACCIDENTS ON RAILWAYS.

THE Caledonian Railway Company have fitted their carriages with a means of communication between the guards and engine-drivers. It consists of a wire passing through iron tubing running beneath the carriages, close to the wheels. One extremity passes round a small cylinder in the guard's break-van, and the other is fastened to a strong spring attached to a bell which is fixed on the tender of the engine. When the guard wishes to communicate with the driver, he gives a slight turn to the handle of the cylinder. The wires being tightened, pull back the spring, which, when it rises to a certain distance, detaches a hammer, which strikes the bell with considerable force. A back turn of the cylinder enables the spring to seize the hammer and again detach it, and thus as many strokes may be given to the bell as the guard pleases. The wire is detached at each carriage, and is coupled together by a loop. In case of breakage, two wires are used, one passing along each side of the carriage, and both are carried round the cylinder.

BONELLI'S SYSTEM OF RAILWAY SIGNALS.

M. BONELLI's system consists of a thin iron bar running parallel to the rails, and fixed edgewise upon insulators of earthenware, which raise it about three inches above the surface. A combination of springs establishes a communication between this bar (which the inventor calls a *line-bar*) and a telegraphic apparatus fitted to one of the wagons. For a full illustrated description of Chevalier Bonelli's apparatus, see *Mechanics' Magazine*, p. 315, No. 1678.

RAILWAY AND MARINE SIGNALS.

A VERY useful application of Captain Norton's Frictional Exploding Signal has been demonstrated to fire the alarm-signal some fifty yards in *front* of the engine-driver. This is effected by the pressure of the engine against a connecting wire or cord stretched across the rail breast high, from a post or rod on one side of the line, round another on the opposite side, and tied to the igniting-wire of the signal. The pressure of the engine draws the cord, and fires the signal in *front* of the driver. A floating marine danger-signal has also been produced. This signal is in the form of a buoy, the covering or lid projecting about two inches beyond the body of the buoy; the frictional-igniter is placed in the centre of the lid, and on the ship pressing against the projecting lid, the igniter fires the charge, the pressure being from the circumference to the centre when the igniter is placed.

RAILWAY SWITCHES.

A REPORT has been read to the Institution of Civil Engineers, "On the Construction of Railway Switches and Crossings," by Mr. B. Burleigh. The writer said many attempts had been made to introduce improvements in the construction of switches and crossings, which had been more or less successful. Among those chiefly deserving attention were, Wild's system of housing the tongue-rail of the switch beneath the top flange of the fixed rail; Parsons's solid point rail switches and crossings; Baynes's switch, with its deep tongue-rail, intended to clear the sliding chairs of any dirt lodging upon them; and Carr's crossing, in which pieces of metal were welded under those portions of the upper table of the wing and point rails most exposed to abrasion and compression. These, although advantageous modifications, were still susceptible of improvement, particularly in the weakest parts, which were the outer rails of the switches, and the wing rails of the crossings, in the line where the outer edge of the wheels crossed them in a diagonal direction. A great defect in ordinary switches was the lateral weakness of the tongue-rail, which was sometimes sprung to such an extent by the leading wheel as to open the point sufficiently for the next wheel to run on to the wrong line, and cause serious accidents. Observations of the defects induced the introduction, by the author, of a switch with a projecting piece, rolled upon the tongue-rail, for supporting the flange jf the wheel during its transit over the spot; the surface of the protecting piece being sunk to such a depth below the top of the rail as to correspond with the depth of the flange of a new wheel, which would therefore take a bearing on both the rail and the projecting piece simultaneously. The result, he said, was successful.

HYDROSTATIC RAILWAY BREAK.

THIS invention has been tested on the Hereford and Shrewsbury Railway. To every carriage in the train was appended ordinary breaks. Under each carriage and van was placed a small cylinder, of 4½ inches diameter, with a solid plug or piston, having a stroke of 3 inches. Under the carriage, a tube, of 1 inch bore, was securely fixed, one end of which entered one side of the cylinder beneath the piston, and the other end the opposite side, so that the cylinder and tube formed one continuous chamber. The termination of the tube at each end of every carriage was enlarged so as to form the matrix of a joint for connecting the separate vehicles. The necessary power for moving the pistons attached to the break-levers is obtained by a tube connected with the boiler. The train was stopped, it is said, when going at the rate of 40 miles an hour, in 300 yards; the distance required, when the common break apparatus is used, being 1600 yards. It was thought that, by increasing the area of the cylinder under the tender, any train going 40 miles an hour might be stopped in 120 yards.—*Builder*, No. 641.

TRANSMISSION OF TIME SIGNALS.

MR. C. P. SMYTH has detailed to the British Association the manner in which the Time Ball on Nelson's Monument in Edinburgh, and the machinery connected with it, are constructed and managed. He di-

rected attention to a model which was connected with the wires of the electric telegraph by a wire from the Royal Exchange, erected at the expense of Sir Thomas M'Dougall Brisbane. At 5 minutes to one, 2 minutes to one, and at one o'clock, the time was communicated from the Royal Observatory, in Edinburgh, and indicated by the model. He said that Sir Thomas Brisbane was one of the most earnest promoters of the erection of time-balls at the harbours of Glasgow and Greenock; having, on his many voyages, been convinced of the imminent peril and numerous shipwrecks which arise from the want of correct chronometers for ascertaining the longitude. It was shown by the Greenwich experiments, that there was no inaccuracy to be apprehended on so short a distance as that between Edinburgh and Glasgow.

SWEDISH CALCULATING MACHINE.

MR. H. P. BABBAGE has read to the British Association a paper "On Mechanical Notation, as exemplified in the Swedish Calculating Machine of Messrs. Schutz."

Mr. Babbage said: the system of describing machinery, of which I am about to give a brief outline, is not new. It was published by Mr. Babbage, in the *Philosophical Transactions*, in the year 1826, where apparently it did not attract the notice of those most likely to find it practically useful. It had been used for some years before this in the construction for the Government of the Calculating Engine, which is now in the Museum at King's College, London; and it was also used in the contrivance of the Calculating or Analytical Engine, on which my father was engaged for many years. Indeed, without the aid of the mechanical notation, it would be beyond the power of the human mind to master and retain the details of the complicated machinery which such an engine necessarily requires. Its importance as a tool for the invention of machinery for any purpose is very great, as we can demonstrate the practicability of any contrivance, and the certainty of all its parts working in unison, before a single part of it is actually made. It is important, also, as a means of understanding or explaining to others the mechanism of existing machinery; for it is utterly impossible to make the notation of a machine without comprehending its action in every single part. There are also many other uses, which I shall not now stop to mention. The general principles of the notation are the same now as in 1826; but the practical experience of many years has, of course, suggested many alterations in detail. To understand the construction of a machine, we must know the size and form of all its parts, the time of action of each part, and the action of one part on another throughout the machine. The drawings give the form and shape, but they give the action of the parts on each other very imperfectly, and nothing at all of the time of action. The notation supplies the deficiency, and gives at a glance the required information. Having made the drawings of a machine, we must assign letters to the different parts. Hitherto, I believe, this has been left to chance; and each one has taken the letters of the alphabet, and used them with little or no system. With respect to lettering, the first rules are, that all framework shall be represented by upright letters. Moveable pieces shall be represented by slanting letters. Each piece has one or more working points; each of the working points must have its own small letter; the working points of framework having small printed letters, and the working points of the moveable pieces having small written letters. We have the machinery divided into framing, indicated by large upright letters; moveable pieces by large slanting letters; working points of framing indicated by small printed letters; working points of moveable pieces indicated by small written letters. In letter drawings the axes are to be lettered first. Three alphabets may be used—the Roman, Etruscan, and written. These should be selected as much as possible so that no two axes which have arms or parts crossing each other, shall have letters of the same alphabet. Having lettered the axes, all the parts on them, whether loose or absolutely fixed to them, must be lettered with the same alphabet, care being taken that on each axis the parts most remote from the eye shall have letters

earlier in the alphabet than those parts which are nearer. It is not necessary that the letters should follow each other continuously, as in the alphabet:—for instance, D, L, T may represent three cog-wheels on the same axis; D must be the most remote, L the next, and T the nearest. The rule is, that "on any axis, a part which is more remote from the eye than another, must invariably have a letter which occurs earlier in the alphabet." By this system, very considerable information is conveyed by the lettering on a drawing; but still more to distinguish parts and pieces, an index on the left hand, upper corner, is given to each large letter; this is called the "index of identity," and all parts which are absolutely fixed to each other must have the same index of identity; no two parts which touch or interfere with or cross each other, on the drawings, must have the same index of identity. This may generally be done without taking higher numbers than 9. All pieces which are loose round an axis must have a letter of the same character, Roman, Etruscan, or writing; but a different index of identity will at once inform us that it is a separate piece, and not fixed on the axis.

I shall now endeavour to explain how the transmission and action of one piece on another is shown, beginning from the source of motion. Each part is written down with its working points; those of its points which are acted on are on the left-hand side; those points where it acts on other pieces are on the right-hand: if there are several, a bracket connects the small letters with the large. The pieces being arranged, arrow-headed lines join each acting or driving point of one piece with the point of another piece, which it drives or acts on. It is usually necessary to make two or three additions when a machine is complicated, before all the parts can be arranged with simplicity; but, when done, "the trains," as they are called, indicate with the utmost precision the transmission of force or motion through the whole machinery, from the first motive power to the final result. It is, however, one of the principles of the notation to give at one view the greatest possible amount of information, so long as no confusion is made; and it has been found that without in any way interfering with the simplicity of "the trains," a great deal more information may be conveyed. For instance, whilst looking at the trains, it is often convenient or necessary to know something of the direction of the piece under consideration, and, by the use of a few signs placed under the large letters, we can convey nearly all that is wanted in this respect. Again, though the drawings of a machine are specially intended to give the size and shape of each piece, yet, by the use of some signs of form which are placed over the letters, the shape of each piece may be indicated. It is found that these signs do not confuse the trains; but, on the contrary, extend their use by making the information they convey more condensed, and more easily accessible.

I now pass to "the cycles," as they are termed, or to that part of the notation which relates to the time of action of the different parts of a machine. "The cycles" give the action of every part during the performance of one complete operation of the machine, whatever that may be. Each piece has a column of its own, and the points by which it is acted on are placed on its left-hand, and the points by which it acts on other parts are placed on its right; and each working point also has its own column. The whole length of the column indicates the time occupied in preparing one operation, and we divide that time into divisions most suited to the particular machine. During each division of time that a piece is in motion, an arrow up and down its column indicates the fact; and during the time of action of each working point, an arrow in its column shows the duration of its action. The times thus shown are, of course, only relative and not absolute time; but it would be easy to show both, by making the divisions of the column correspond with the number of seconds or minutes during which the machine performs one operation. The arrows which point upwards indicating circular motion in the direction screw in, and the arrows which point downwards screw out; where the motion is linear, the downward arrow indicates motion from right to left.

A Correspondent of the *Athenæum* says:—"If the Calculating Machine of M. Schutz, of Stockholm, can be brought to construct tables according to the duodecimal scale of Baron Silvio Ferrari, noticed in the *Athenæum* of November, 1854, and all works and calculations in geometry, astronomy, horology, navigation, and military science, short-

ened and made less difficult, a great advantage will be conferred upon the world. An examination into the truth of the matter by competent persons should be made; and if found correct, let a set of the requisite tables be printed without delay, and let England go ahead and carry a light to the nations. The Roman ten, X, or some other sign, would replace the cipher to be removed to the column of dozen or twelves. The eleven might keep its place."

M. Schutz's machine has also been described in the *Illustrated London News*, where it is further elucidated with three engravings.

IMPROVED BORING TOOLS.

PATENTS have recently been obtained in America and Great Britain for "Improvements in Boring Instruments known as augers, bits, or gimlets," the invention of Mr. Ransom Cook, of the United States. These improvements are of a valuable character, and will tend to very considerably diminish the work expended in boring. To shipwrights and others, of whose labour this operation forms a considerable and laborious portion, the invention will be of great utility. It was suggested to the inventor by the microscopical examination of an insect.

The improvements consist in giving to the lips or cutting edges of boring implements a curved or gouge shape at their extremities, as well as in the under cutting or back sloping of those edges, in order to give them a sliding or drawing movement in cutting. To enable others to make and use the improved instruments, the inventor describes their construction and operation as follows:—"The body of the boring implement may be forged for this purpose in almost any of the forms now used, but my cutting edges are most easily adapted to the twist or screw auger and the centre-bit. In drawing or plating for the screw auger with edges on my plan, the extreme or cutting end should be left about square, and thicker than for the ordinary lips. In hammering out the lips before turning them, they should be extended from the screw or centre farther than for right-angular lips. These lips should also be hammered so as to have some projection downwards, that is, project from the handle end, somewhat in the form of a swallow's tail. After the hammer work is finished, the lips, except those for boring endwise, are to be filed or dressed with the under back slope. No particular angle is essential in this slope, but the augers seem to work best and easiest when the slope is at about 45 degrees from the body of the auger. These implements are then to be tempered, finished, and used in the same manner as the ordinary kinds. These boring implements will be found to cut so much easier than those now in use, that they require much less stock on their bodies, and but a small screw to hold them to the wood."—*Mechanics' Magazine*, No. 1683.

EARTH-BORING MACHINE.

MR. COLIN MATHER has described to the Society of Arts a Machine invented by him for Earth-boring, the chief novelties in which consist in the form of the boring head and the shell-pump, and the mode of acquiring the percussive motion. The latter is accomplished by means of a steam cylinder, the steam being admitted at the bottom only. A

cast-iron rod in connexion with the piston raises the pulley over which the guide-rope is passed, and so lifts the boring-head. When the piston has reached the top of the stroke, a projection in the same rod is made to act on a cam, by which the steam is shut off, and the exhaust-port is opened. The boring-head and piston then fall by their own weight. Very favourable results were said to have been attained by the use of this machine; but it is right to add, that Mr. Herbert Mackworth stated in the discussion which followed its description, that still higher results had been attained in Germany by the use of an apparatus invented by Herr Kind.—*Society of Arts Report.*

MARINER'S COMPASS.

MR. G. GOWLAND, of Liverpool, chronometer and nautical instrument maker, has patented a new description of Mariner's Compass, having cards of a spherical, cylindrical, or other similar form, with the points marked on their peripheries. The nature of the invention is described as follows:—"The inventor constructs a compass with the points or graduations marked on the exterior periphery of a zone-shaped card, instead of upon the upper surface of a flat card; and is thereby enabled to raise the compass to a considerable height above the deck of the vessel, and thus to diminish the local attraction of the iron-work of the vessel; at the same time the indications are rendered very distinct, and the steersman is enabled to see both the head of the vessel and the compass with a much less movement of his eye."

MR. J. GRAY, of Liverpool, has invented a method of so arranging and constructing Ships' Compasses as to counteract the vibratory action to which they are subject in steamships and other vessels. The compass is suspended within a vessel or bowl, which is held in a state of suspension within another vessel or bowl containing fluid, which Mr. Gray prefers to be of thick varnish, on account of its adhesive and sluggish action, which is beneficial in keeping the inner bowl steady. Mr. Gray connects the bottom of the inner vessel or bowl with the bottom of the outer vessel or bowl by springs; and he also connects the upper and inner rim with the outer rim by vulcanized India-rubber or other springs; the inner vessel or bowl being kept in a central position by tangential screws, so as to counteract the lateral action, whilst the springs below will regulate the vertical position of the inner bowl in conjunction with the fluid contained in the outer bowl.

IMPROVED SLIDING RULE.

MR. CHARLES HOARE has devised certain modifications in the Sliding Rule: there is much that is new and useful in the arrangement, and the changes introduced will evidently simplify the method of using an instrument scarcely yet sufficiently understood, and certainly not so extensively employed in making calculations as it deserves to be.

The chief advantages of the New Rule are a series of new gauge-points, by which brickwork of any thickness can be converted to standard, or cubic measure; a table of constants, to facilitate the forming of estimates, and the gauge-points for polygons and circles, very

clearly tabulated; with concise formulæ for the various operations, which, with the necessary gauge-points, are engraved on the face of the instrument, thus preventing the necessity for trusting to, or taxing the memory.

By some slight mechanical improvements, the rule is also made useful in plan drawing; and the whole is evidently got up with the care and excellence of manufacture, generally found in the rules and scales manufactured by Mr. Tree.—*Proceedings of the Institution of Civil Engineers.*

MITCHEL'S TYPE-SETTING MACHINE.

THIS Machine, the invention of the brother of John Mitchel, the Irish agitator, is described in *The New York Evening Mirror* as working with remarkable accuracy and rapidity, at Trow's Printing Office, in Queen Anne-street, New York. "We have before us," says the Report, "a couple of pages of the 'first proof' of this machine-work; and it is remarkably free from errors. The machine is of a triangular shape, somewhat resembling a grand pianoforte, only not as large. It has a key-board corresponding to the letters of the alphabet and the 'punctuation marks,' as the keys of the piano represent the various notes in the scale of music; the work is done by playing upon the finger-board precisely as tunes are played upon the pianoforte.

"This part of the performance is done by girls, who acquire the art with great facility. The letters are supplied by long galleys, each filled with a single letter, which require constant replenishing; and every touch upon the key sends the desired letter into a long line beneath the machine, from which it is taken by a compositor, broken into lines to suit the width of his page or column, and justified. The 'distribution' of the type is as ingeniously managed as the 'composition.' Mr. Trow informs us that one of these machines will do the work of five men. The following additional details are from the *New York Tribune*:—

"Five give employment to ten large, and an equal number of small girls, with a foreman to oversee, and one additional female to supply the machines with type. Two compositors alternately relieve each other, first setting and next justifying a quantity of matter, while the smaller attendants busy themselves in distributing and arranging the type for the machines. Three thousand 'ems' of long primer have been set up per hour, or twenty-six thousand in a day of ten hours, by one girl; but much depends, of course, on the skill of the operator."

MACHINE FOR MAKING BUTT HINGES.

MR. CHARLES MILLER, of New York, in patenting a machine for manufacturing hinges, claims a series of punches, which cut out two blanks of proper shape, with a pair of bending rollers, for giving the proper bend to form the joint: by this means, two pieces of metal, fed at proper intervals, are cut, bent, and put in position ready to receive the pin; so controlling the action of the punches, rollers, and cutters, that they act nearly simultaneously during each intermission of the feed movement, the rollers following the punches, and the cutters succeeding to the rollers; the arrangement of wire feeder and cutting apparatus,

and the press which carries the closing die that the rotating wheel may hold the hinges—first to receive the wire for the pin, and afterwards to have it closed or rivetted—an eccentric curved piece for finishing the insertion of the pin in the wheel, and the general combination of the several mechanical arrangements forming a machine for the manufacture of hinges from bars or strips of metal complete at one operation.—*Mining Journal.*

FILE-MAKING BY MACHINERY.

A FILE-CUTTING machine has been patented by a Mr. Ross, of Glasgow. By its agency, says the *North British Mail*, files can be struck, and that in a superior manner, with an advantage in labour alone of at least 200 per cent. over the old process of hand-striking. A skilled file-cutter will strike by the hand somewhere about twenty common forty-inch flat bastard files in a day. One of Mr. Ross' machines, under the direction of a boy, will strike sixty files in the same amount of time. The machine is so simple, too, that an uninitiated boy can in a few hours be instructed to attend it. A one-horse steam-power is capable of driving six of these machines; and, with some practice, a lad might be able to attend two of them, for they stop of themselves when a certain portion of work has been completed. The machine-made files have already found their way extensively into use, even on the other side of the Atlantic.

IRON-PLATE CUTTING MACHINE.

A NEW machine for this purpose has been made by Mr. Caldwell, engineer, Glasgow. It weighs between six and seven tons. The action of cutting the plates is said to be exceedingly simple. The machine can cut plates varying in thickness from $\frac{7}{8}$ths of an inch to the thinnest made, and $7\frac{1}{2}$ feet in length. One of the blades is stationary, the other circular, and fixed to a wheel and pinion, and can be driven either by the hand or by any other power. It is expected to supersede the present tedious method of boring and chipping the edges of plates used in ship-building, as it can cut the plates at any angle, and with a straight edge. The invention is American, but the patent, it is said, has been secured for Britain. There is a machine of this kind in operation in one of the Government dockyards.—*Builder*, No. 663.

MACHINE FOR QUARRYING SLATE.

MR. H. J. BREMNER, of Nazareth, Pennsylvania (U.S.), has introduced a machine to supersede the process of cutting grooves in slate rock to a certain depth by the common pick, and then taking off the several layers of stratification to form roofing rectangular slates. The machine is worked by hand, and is so constructed that the cutters having formed a channel forward, it turns at right angles, and cuts a transverse groove: this operation being continued, cuts out the four perforations with great rapidity, and perfectly true. It is stated that one man can cut as much slate in a day by this means as twelve men by the old pick system.—*Builder*, No. 628.

FIRE-BRICKS.

Mr. George Noble, of Pensher, has patented an invention, by which it is proposed to do away with manual labour in the manufacture of Fire-bricks made from ground clay; by passing it directly from the grinding mill to the machine, where it is made into bricks ready for the kiln, instead of adding water and making it into a paste, according to the present process. This operation will save the expense of drying flats, and coals, now used for preparing bricks for the burning kiln, and will prevent any alteration in form of the wet brick by handling. The invention consists of a combination of hydraulic machinery, for compressing clay in a pulverized state into bricks; and for changing the position of the moulds in which the clay is compressed, so that they may fill and discharge themselves after compression.

IRON INDUSTRY OF THE UNITED STATES.

A paper has been read to the Society of Arts "On the Iron Industry of the United States," by Professor Wilson, F.R.S.E. The iron-making resources of the States are very great—the distribution of ores, many of the richest description, is general throughout the Atlantic and Western States, while the enormous area occupied by the coal measures testifies to the abundance of fuel for the development of industrial occupations. The make of iron is at present about 700,000 tons, about one-half of which was consumed for castings; and the remaining portion is converted into wrought-iron, at a loss in waste, &c., of about one-third. As the present annual consumption amounts to 1,200,000 tons, or nearly 88lbs. per head of the population, there is a deficiency of 500,000 tons to be supplied by other countries. This large importation is obtained entirely from Great Britain, and forms a very important item in the commercial intercourse of the two nations. In fact, our export of iron to the States is one-third more than our export to all other countries. The difference in price between the two markets may be taken at 80 per cent. This includes all charges for freight, commission, insurance, &c., about 50 per cent., and the ad valorem import duty of 30 per cent. In round numbers, pig iron selling at Liverpool at 45s. to 50s. would cost 20s. at New York. Everywhere in the States the charcoal forge is giving way to the superior advantages of the hot-blast anthracite furnace, economy of production being the main object now sought to be obtained. The use of the waste gases of the furnace is now becoming universal; and attempts are being made also to utilize another waste, and at the same time cumbersome product, the slag or cinder, by a process of annealing. Some specimens produced at the Dowlais furnaces by the same process were exhibited. The last point to which attention was drawn was that of making wrought-iron *direct* from the ore. The process referred to was patented in 1851, and is in operation at Cincinnati, and at Newark, New Jersey; and another on the same principle by General Harvey, is carried on at Motthaven, New York. In both the conversion is effected by mixing the ores with from 20 to 25 per cent. of fuel. The ore and fuel are reduced to a coarse powder and intimately mixed. They are then led into a series of hoppers or mufflers, around

which the flames and gases from a furnace play. By these means the fuel is ignited, and burns at the expense of the oxygen of the ore, and metallic iron is left mixed with the foreign substances usually accompanying such minerals. This reduced ore then descends down a shoot to a furnace suitably arranged, and is subjected to a temperature sufficient to bring the iron to a pasty condition, when it is worked together in a puddling furnace, and drawn out in balls of the required size for tilting.

MINERAL INDUSTRIES OF THE UNITED KINGDOM.

MR. ROBERT HUNT, F.R.S., Keeper of Mining Records, has read to the Society of Arts a paper on this important inquiry. Tin first claimed the author's attention. It was obtained at a very early period in western Cornwall, and the districts westward of Helston and those around St. Austle were the localities from which the ancients most probably derived their supplies. Tin mining, in the strict sense of the term, was unknown before the time of the Romans, previous to which it was obtained by washing the drift deposits of the valleys. The total quantity of tin ore raised in Cornwall and Devon in 1853 was 8866 tons, the average value of which was 68*l.* per ton, producing 65 per cent., or about 6000 tons of metallic or white tin; we also imported about 2500 tons, and re-exported about 1000 tons of the foreign tin, and rather more British. A process invented by Mr. Robert Asland has lately been put in operation at the Drake Walls mine for the purification of tin ore. It is essentially one for effecting the combination of tungstic acid of the woolpaur with soda, by roasting and dissolving out the tungstate of soda. A process introduced by Mr. J. A. Phillips also promises many advantages.

Out of the tin produce another branch of mineral industry, though not a very large one, arose. This is the production of Arsenic, estimated at 2000 tons annually. The chief market for this is, however, now closed, the principal portion having been used in the preparation of Russian leather. The importance of scientific knowledge to our mining population is well exemplified by the fact, that hundreds of tons of the grey sulphuret of copper have been thrown over the cliffs of the western shores into the Atlantic Ocean, and hedges have been built with copper ores of twice the value of the ordinary copper pyrites. Indeed, for a long period, tin mines were abandoned when the miner came to the *yellows*—the yellow copper pyrites; and only about one hundred years back was attention drawn to the value of these ores. Now there are about one hundred copper mines in Cornwall, the annual value of the produce of which amounts to 1,200,000*l.* The smelting is carried on at Swansea, where the Cornish copper ore is combined with the rich ore imported from Cuba, Chili, Peru, Spain, South Australia, &c., from which we import some 53,000 tons annually. In 1854, about 30,000 persons were employed in and about the Cornish mines. Of these 5500 were women, and 5000 children. Nearly all the lead ores raised in this country contain more or less silver,—the ores of Derbyshire, and of the northern counties containing the least, while those of Devon and Cornwall contain the most. Formerly it was not profitable

by the processes adopted—the oxidation of lead—to separate the silver when it existed in less proportions than fifteen ounces to the ton. By the process of desilverisation introduced by Mr. H. L. Pattinson, F.R.S., it is now economical to separate the silver when no more than five ounces existed in a ton of lead. A process has lately been introduced in which zinc is employed in combination with the fused metal; by the action of affinity the silver is thus readily separated. The manufactures of carbonate or white lead, and of a new white lead, which is an oxy-chloride of lead, were then noticed. Nearly the whole of our supplies of zinc ores are derived from the Vielle Montagne, there being but two or three zinc smelting establishments in Great Britain, and few metallurgical processes are more crude than the operation of reducing zinc to the metallic state. The author then alluded in succession to manganese, antimony, nickel, and cobalt, our clays and salt, passing thence to coal and iron.

The raw material of our Mineral Industries may be estimated for the past pear at about 34,000,000*l*. sterling. Experience has hitherto done everything for those engaged, science but little. The vast speculation so injurious to legitimate mining, the child of ignorance or fraud, is the direct consequence of the want of that exact observation and system of record which sooner or later will establish some constants by which mining industry may be guided. Again, humanity demands that no effort should be spared to lessen the frightful loss of life—nearly one thousand men—annually sacrificed in our coal-mining operations.

NEW FORMULA FOR CAST-IRON BEAMS.

Mr. Fairbairn, in his recent work on Cast and Wrought Iron, states that, for bridges, warehouses, &c., cast-iron beams should not be loaded with more than one-fifth or one-sixth of the breaking weight. The following simple formula will give the safe load in cwts. equally distributed at one-fifth the breaking weight. It is derived from Mr. Hodgkinson's formula for the breaking weight in tons in the middle :—

$$W = \frac{26\,a\,d}{l}$$

where W = breaking weight in tons.
a = area of bottom flange in inches.
d = depth of beam in inches.
l = length between supports in inches.

The new formula is—

$$S = \tfrac{4}{5}\,\frac{26\,a\,d}{L}$$

where S = safe load equally distributed in cwts.
a = area of bottom flange in inches.
d = depth of beam in inches.
L = length between supports in feet.

The beams are supposed to be of Mr. Hodgkinson's section of greatest strength, the flanges being in the proportion of 6 to 1.—*R. H. Skaife; Journal of the Society of Arts.*

MANUFACTURE OF STEEL.

Mr. Sanderson has read to the Society of Arts a paper "On the Manufacture of Steel," which thus concludes:—

From the outline which I have given of the processes by which various steels are manufactured, it will be seen that there are in each great defects, want of uniformity, temper, or clearness of surface, unfitting them for many useful purposes. To obviate these defects, both bar converted and also raw steel are *melted*, by which the metal is freed from any deleterious matter which the iron might have contained; a uniform and homogeneous texture is obtained, whilst an equality in temper or degree of hardness is secured; besides which the surface is capable of receiving a high, clear, and beautiful polish—qualities which the other steels I have described do not possess. The first steel which may be called cast steel is the celebrated Wootz of India; it is produced by mixing rich iron ore with charcoal in small cups or crucibles. These are placed in a furnace, and a high heat is given by a blast. After a certain time this ore melts and receives a dose of carbon from the leaves and charcoal charged with it. The result is a small lump of metal with a radiated surface about the size of a small apple cut in two; it is very difficult to work; nevertheless, swords and other steel implements are manufactured from it in the east; it is not found in England as an article of commerce. The melting of bar steel was first practically carried out by Mr. Huntsman, of Attercliffe, near Sheffield, whose son yet conducts its manufacture, for which he enjoys a very high celebrity, by making use of the best materials, and insisting upon the most careful manipulation of his steel in every process. The manufacture of cast steel is in itself a very simple process. Bar steel is broken into small pieces, which are put into a crucible, and are melted in a furnace about 18 inches square and 3 feet deep. The crucible is placed on a stand 3 inches thick, which is placed on the grate bars of the furnace. Coke is used as fuel, and an intense heat is obtained by having a chimney about 40 feet high. Although a very intense white heat is obtained, yet it requires 3½ hours to perfectly melt 30 lbs. of bar steel. When the steel is completely fluid, the crucible is drawn from the furnace, and the steel is poured into a cast-iron mould. The result is, an ingot of steel, which is subsequently heated and hammered, or rolled, according to the want of the manufacturers. Cast steel is not only made of many degrees of hardness, but it is also made of different qualities; a steel maker has, therefore, to combine a very intimate knowledge of the exact intrinsic quality of the iron he uses, or that produced by a mixture of two or three kinds together; he has to secure as complete and as equal a degree of carbonization as possible, which can only be attained by possessing a perfect practical and theoretical knowledge of the process of converting; he has to know that the steel he uses is equal in hardness, in which, without much practice, he may easily be deceived; he must give his own instruction for its being carefully melted, and he must examine its fracture by breaking off the end of each ingot, and exercise his judgment whether or not proper care has been taken; besides all this knowledge and care, a steel maker has to

adapt the *capabilities* of his steel to the *wants* and *requirements* of the consumer. There are a vast variety of defects in steel as usually manufactured; but there are a far greater number of instances in which steel is *not adapted* for the manufacture of the article for which it was expressly made. Cast steel may be manufactured for planing, boring, or turning tools; its defects may be, that the tools when made, crack in the process of hardening; or that the tool whilst exceedingly strong in one part, will be found in another part utterly useless.

TEMPERING OF STEEL.

In the discussion on Mr. Sanderson's paper, "On the Manufacture of Steel," read to the Society of Arts, an inquiry was made as to the kind of steel suitable for particular articles, and how its quality might be tested. This gave rise to the remark that the Tempering of Steel depended on the skill and experience of the workman. Mr. Harry Scrivenor, of Liverpool, has, however, obtained from a clever workman the following memoranda on the subject:—

"I received your letter inquiring what steel was best for different kinds of manufactures. I should say cast-steel, if it can be applied; double shear for hatchets, or any kind of edge tool that cannot be well made of cast-steel. The temper to be as follows:—

"1st. For boring cylinders, turning rolls, or any large cast-iron, let it be as hard as water will make it, minding not to heat it more than a cherry red.

		Degrees Fahr.
2nd.	Tools for turning wrought-iron pale straw colour	430
3rd.	Small tools for ditto, shade of darker yellow . .	450
4th.	Tools for wood, a shade darker	470
5th.	Tools for screw-taps, &c., still darker straw colour	490
6th.	For hatchets, chipping-chisels, brown yellow . .	500
7th.	For small rimers, &c., yellow, slightly tinged with purple	520
8th.	For shears, light purple	530
9th.	For springs, swords, &c., dark purple	550
10th.	For fine saws, daggers, &c., dark blue	570
11th.	For hand and pit-saws, &c., pale blue	590

"The temper greatly depends on the quantity of carbon that is in the steel—this the practical man soon finds out, and he tempers or draws down the tool accordingly."

BRONZE CASTING FOR THE COLOSSAL WASHINGTON MONUMENT.

The casting at Munich of the horse for the above monument is one of the great feats of modern foundry, as fifteen tons of bronze had to be melted and kept in a state of fluidity. For several days and nights previously, a large body of fire was working at the huge masses, which required to be stirred at times, to which they answered in a grumbling tone. Still, when the bronze was entirely liquified, an ultimate essay was made in a small trial cast, and for heightening the colour some more copper was even then added. Successively, all the chambers through which the metal had to flow in the form were cleared of the coal with which they had been kept warm, and the master ultimately examined all the air spiracles and the issues of the metal; then the props of the different tubes were set, and every man had his duty

and place assigned to him. Finally, the master, amidst the intense expectation of the many art-amateurs present, pronounced the words, "In the name of God;" and then three mighty strokes opened the fiery gulf, out of which the glowing metal flew in a circuit to the large form. The sight was magnificent; and in the little sea of fire stood the master, and gave his commands about the successive opening of the props. Hot vapour poured forth from the air spiracles; in the conducts the metal boiled in waves; still, no decision yet, as the influx of the bronze in the very veins of the figure could be but slow. At once flaming showers jumped out of the air-conducts, and the master proclaimed the cast to have *succeeded*. A loud cheer followed, when the master approached Mr. Crawford, the artist of the Washington monument, to congratulate him on this success. Another cheer was given to M. de Miller, the chief of the Royal Foundry of Munich, who had personally conducted the work.—*Builder*, No. 665.

CAST-STEEL BELLS.

The *Sheffield Independent* records that the firm of Naylor, Vickers, and Co., Millsands, have introduced into Sheffield a new trade, in the making of Cast-Steel Bells. These bells are extensively used in Germany; and steel has these advantages over bell-metal, that the bells may be made thirty per cent. lighter, are only about half the price, and are very much stronger. We often hear of much hesitation about ringing the bells of old churches, for fear of danger to the tower. If the bells could be replaced by others of only two-thirds their weight, it would probably obviate the difficulty. In casting a steel bell weighing 25 cwt., it required fifty-six pots of steel, and the whole were poured with rapidity and order in five or six minutes. The casting is said to have been successful, producing a sound bell of great size and power, and of good tone.

NEW IRON SHOT-TOWER.

A Tower formed of cast-iron, for the manufacture of shot, has been erected in New York, by Mr. J. M'Cullough, a shot manufacturer; the designer and builder being Mr. James Bogardus, who is called the first projector of iron houses. The foundation of the tower is of solid masonry, 4½ feet thick, on a basis 18 feet below the surface of the ground, and 25 feet diameter: on this is bolted the first portion of the iron structure, through twenty holes, 18 inches apart, by wrought-iron bars 2 inches diameter, to which the lower tier of cast-iron pillars is keyed. This tier of cast-iron columns supports the entire superstructure; they are said to be of sufficient strength to sustain a weight of 28,000 tons. Upon the tops of the first tier of these columns rests a cornice, made in ten sections, each pair meeting over the centre of a column. Upon the lines of junction stand the next tier of columns, then another cornice, succeeded by more columns, all made to break joint, and firmly bolted together. These are carried up to the height of 174 feet above the ground. The tower tapers from 25 feet outside diameter to 15½ feet, the inner compartment being 2 feet less. The

metal employed in the construction is something under 100 tons, less than 170th part of what the first tier of columns would sustain. Mr. M'Cullough estimates that this tower is capable of making 5000 tons of shot per annum.—*Builder*, No. 671.

SINGULAR PROPERTY OF WIRE.

THE partner of a large manufacturing firm for telegraph cables states, that on receiving new Wire from the wire-drawers, it was often found so brittle that they could not work it. On observing this, they threw it aside for some months, by the end of which its brittleness disappeared, and it was found to be tough and good.—*Herapath.*

PRESERVATION OF TIMBER.

MR. A. E. PASCHAL LE GROS, of Paris, and Castle-street, London, has patented "a new mode of effectually Preserving Timber and all kinds of wood" by means of a cheap chemical compound, which does not destroy the fibrous structure of wood, or otherwise injure it. For this purpose there is employed a solution of muriate or hydrochlorate of manganese, resulting from the manufacture of chlorides of lime and of the bleaching liquid called lye, or water of gavelle, or chloride of potash, which residue is at present treated by manufacturers as waste. This salt containing a great portion of acid, it is neutralized by the admixture of chalk (carbonate of lime) or of oxide of aluminum. The salt when thus reduced to a neutral state, gauges by the aërometer, used for concentrated acids, from 30 degrees to 35 degrees; and may, therefore, be easily carried to the place where it is to be applied as a solution, containing three parts weight water to one of acid. The acid in the residue may also be neutralized, and the ferruginous matter in it precipitated by means of oxide of zinc. There is thus obtained a double salt of manganese and of zinc, which is said to have the same or superior preserving qualities, as the double salt of manganese and of lime produced, as above described. This double salt of manganese and of zinc may be very efficiently applied to absorbing the effluvium of putrid or putrescent matter. For preserving wood the solution obtained in either of the two ways described is poured into a trough, and the immersion of the logs, or pieces of wood, is effected by placing them vertically in the trough, in such manner that they are steeped in the liquid to about three quarters of their length. The wood is thus subjected to the action of the solution, during a length of time varying from twelve to forty-eight hours. The solution rises in the fibres of the wood, and impregnates them by the capillary force alone, without requiring any mechanical action, whilst a horizontal immersion under the same circumstances has been found to produce no satisfactory effect. The timber which has been thus prepared is said to acquire new properties,—to become incombustible: neither has change of temperature any influence upon it. "It is hardened, and the preservation is more lasting than that effected by metallic sulphates, which weaken the ligneous fibre, and impart to wood brittleness, and a tendency to crack and warp under the action of heat." The patentee further re-

marks, that it will be easy, and in some cases convenient, to combine the good effects of creosote with those of either of the two solutions obtained as above described. For this purpose he dissolves in concentrated sulphuric acid a variable quantity of some tarry or resinous oil; he then dilutes this solution with water, and mixes a suitable quantity of it with the solution of muriate of manganese when required.

VENTILATION BY FANS.

A PATENT has been granted to Lieut. Cook, R.N., F.R.S., Professor of Fortifications at Addiscombe, "for improvements in the method of Working Gigantic Fans, called punkas, for agitating the air in hospitals, barracks, churches, and other large buildings in tropical climates, and in the height of summer in more northern latitudes." These punkas may be worked by manual labour, or by horse, bullock, or steam power. The machine is so arranged, that one man can work sixteen punkas with comparative ease. This is the number usually required for fanning the occupants of thirty-two beds, arranged in pairs, in an Indian hospital. The action of any single punka may be arrested without affecting the onward motion of the others, and set to work again at the will of the patient. For private beds, "revolving fans" are used, *within* mosquito curtains: these fans, by a simple and noiseless mechanism, are made to fan the occupant for two, four, six, or eight hours, according to the temperature of the room, and the consequent speed required.—*Builder*, No. 659.

LIGHTING AND HEATING.

MR. JOHN LONGBOTTOM, of Leeds, has patented some improvements in combining atmospheric air with hydro-carbons for the purpose of producing Light and Heat. The invention consists in causing the atmospheric air, which is to be combined with hydro-carbons for the purpose of light and heat, to be passed in contact with pumice-stone, or other porous substance, saturated with caustic potash; and then to be passed in contact with pumice-stone, or other porous substance, saturated with sulphuric acid, in order to free the air from water. The dry and pure air is then passed in contact with the hydro-carbon to be used, which, combining with the air, produces a compound suitable to be used in place of gas. The air is propelled through the process by bellows or blowing apparatus; and is caused to pass into, and in contact with, the hydro-carbon employed in a divided or thin stream by means of cups and floats; the combined matters then pass into a gasometer, from which they are supplied for use in like manner as gas. By passing atmospheric air through a bath of pumice-stone, or any other suitable porous substance saturated with caustic potash, for the purpose of absorbing the carbonic acid gas contained in the air, and then through a bath of pumice-stone, or any other suitable porous substance saturated with sulphuric acid, for the purpose of absorbing any watery particles or aqueous vapours, and thus thoroughly desiccating or drying the air, and fitting it for the absorption of the vapours of hydro-carbons, it is said to be rendered highly luminiferous, and well

suited for all the purposes of which illuminating gas is susceptible.—*Journal of the Society of Arts*, No. 150.

THE TORBANEHILL MINERAL.

THE Queen's palace, says the *Border Advertiser*, has been for some time lighted by means of this valuable substance, gas from the Torbanehill Mineral being destitute of sulphur. In 1854, 10,000 tons of the mineral were sent to London alone. Not long ago the French Government published a Report regarding this substance, which had previously lighted up the whole of the Hôtel des Invalides. This Torbanehill mineral, adds our authority, is the means now resorted to for illuminating many foreign capitals, and it is sent to the most distant part of the globe. A ship loaded with blocks of this mineral conveys an enormous quantity of a peculiar oil, the source of the illuminating power, in the smallest possible bulk; 75 per cent. or three-fourths of the substance being latent oil, and the rest pure clay.

NEW REFLECTOR FOR LIGHTS.

A NEW Reflector for Lights has been exhibited at the Institution of Civil Engineers. It was composed of silvered porcelain, and appeared to possess a very brilliant polish, which was stated to be indestructible. Hitherto reflectors of small sizes only had been produced, but by means now adopted it was expected that they could be made as large as 21 inches in diameter over the mouth. If this manufacture was brought to the perfection that was anticipated, great economy would result, as the silvered copper reflectors, at present used, were very expensive originally, were liable to oxidation, and were frequently injured by the care of the attendants, in rubbing them to keep the reflecting surfaces bright. The new porcelain reflector had been transmitted by the Honourable Major Fitzmaurice to Captain Washington, R.N., by whom it was introduced to the notice of the meeting.

MR. BABBAGE'S OCCULTING LIGHTS.

MR. BABBAGE suggests the application of this system to military operations conducted in the night. He says:—

The failure of the Sebastopol assault on the 18th of June has been ascribed to the mistake of a signal made by the general commanding one of the attacks—the fuse of a shell was mistaken for a rocket, the signal previously agreed upon. One of the most extraordinary features of the present war is the singular neglect by the allies of those aids which a highly advanced state of mechanical science places at their disposal.

The Russians, on the contrary, have for years examined and systematically treasured up every invention which could contribute to their success.

It requires no profound military skill to perceive that, under the peculiar features of the localities around Sebastopol, where combined attacks are directed by two commanders-in-chief, it is important that

they should possess, if possible, means of instant communication with each other. It is still more important that each commander should havé instant means of conveying orders to the leaders of each of his several attacks. Had this been the case, the mistake of a signal would have produced but little inconvenience, because it might, as soon as perceived, have been rectified. The commanders-in-chief might communicate with each other by a portable electric telegraph; but this instrument could not be used by the advancing troops. A more effective instrument would be some simple telegraph, fixed at the two stations chosen by commanders-in-chief.

During a night attack a very simple form of telegraph might be used, which has already been proposed for enabling ships to communicate with lighthouses or other vessels; it is called the "occulting telegraph." Its principle is equally valuable for enabling the seamen to read the number of anygiven lighthouse as soon as it appears above the horizon, or forcommunicating his own necessity for assistance or the news he brings.

The best lighthouses consist of one argand lamp, surrounded by glasses, which concentrate the greater part of the light in a direction parallel to the surface of the sea. Now, it is well known that if an opaque cylinder is lowered over the glass of an argand burner the light will be entirely hidden. If the shade be lowered, and then quickly raised, the light will suffer a temporary extinction, which is called an "occultation; at whatever distance the lamp can be seen this occultation will be perceived. It has been found by experiment that if these occultations succeed each other at about the distance of one second, they can not only be seen, but be easily counted. Here, then, is a ready means of expressing small numbers. To express large numbers, as, for example, 374, it is only necessary to make three successive occultations, and allow a pause of five seconds; make seven successive occultations, and allow a pause of five seconds; make four successive occultations, and allow a pause of twelve seconds. After this the series may be repeated.

Thus the number 374 can be communicated to all within sight of the lamp in little more than half a minute. One great advantage of this system of signals is, that the number can be repeated by mechanism until it is acknowledged to have been observed. In the case of a lighthouse, the same number must be repeated from sunset to sunrise. Another advantage is, that this kind of telegraph is adapted to all existing numerical codes of signals. During the day the light of the sun itself might be used for an occulting telegraph. The distance at which sunlight could be employed might, under favourable circumstances, extend to about 100 miles.

In 1851 an occulting light was publicly exhibited in London. The plan was at that time communicated to the Trinity House.

Occulting lights were subsequently approved by the Light-house Board of the United States, and Congress appropriated 5000 dollars to make experiments upon them.

I have also evidence that the occulting system of lights was known at St. Petersburg in 1853, and I infer that it has been practically

applied at Sebastopol from the following extract from the letter of the *Times*' correspondent at Balaklava — (*Times*, July 11) :—

"A long train of provisions came into Sebastopol to-day, and the mirror telegraph, which works by flashes from a mound over the Belbeck, was exceedingly busy all the forenoon."

This can scarcely apply to any other than an occulting telegraph.—*Mechanics' Magazine*, No. 1667.

NEW HEATING APPARATUS, BY MEANS OF FLUIDS.

GENERAL H. DEMBINSKI, of Paris, has patented in this country, as well as in France and Belgium, new arrangements for Heating rooms, large buildings, and hothouses, and for Cooking and other purposes. The general principle is such an arrangement of fluted or plain tubes, with tufts of wire passing through them, to be heated in any convenient manner, as, while hot, can have water continually to flow over or through them. This heated surface being extensive, in proportion to the water to be heated, keeps the latter in a constant state of ebullition; and by passing it in that state through other pipes, so as to re-circulate over the heated surface, great economy of fuel is estimated to be the result. Ornamental vases, pillars, plinths, and other architectural and fanciful designs, may be made the heating medium in halls, staircases, single apartments, &c. One peculiar arrangement is adapted to camp purposes, combining a heating apparatus with a large caldron for cooking the mess for the troops.

SMOKELESS FURNACE.

IN a steam-boiler furnace in action, on a twenty-five horse-power boiler, at granaries and flour-mills at Winchester Wharf, Southwark, every alternate bar is so connected with a cross-piece at each end as to form one entire moveable frame, which is connected by gearing with the motive-power. The motion given to it is angular. What are termed the stationary bars are not fixed as usual, but hung so as to balance the vibrating frame with the load of fuel which it has to move. The fuel is fed through a hopper and regulating incline plane, and the whole is self-acting, requiring, it is said, but little attention from the stoker. The saving of fuel is estimated at about ten per cent.—*Builder*, No. 642.

SMOKE CONSUMPTION.

A LECTURE has been delivered at Sheffield, by Mr. Cashin, C.E., "On Heat in relation to the combustion of fuel, and the perfect combustion of Smoke." The schemes introduced for the consumption of smoke under a system of rapid combustion were classed by the lecturer under three heads :—1. Those which cause the smoke from the fresh coal to pass through or over the more perfectly-ignited fuel. 2. Those which provide for the admission of a supply of air to the gases. 3. Those which have a jet of steam thrown into the furnace or chimney. A number of the smoke preventing contrivances belonging to each of these classes were described, and their several advantages and defects pointed out. In

reference to a plan by Mr. Ashberry, of Sheffield, he stated that, posterior to the bridge, Mr. Ashberry introduces a combustion chamber the full width of the space between the boiler seating. The second bridge or wall of this chamber is built close up to the boiler, within an aperture in the centre, reaching to within about nine inches of the boiler. Through this aperture the flame and gases from the fire must pass. In passing over the first bridge the gases are checked in the centre and directed towards the sides of the furnace, so as to cause them to impinge against the part of the second bridge farthest from the aperture. In rushing to and through this aperture the flame and gases are commingled and the gases thoroughly mixed, and if sufficient uncombined oxygen be present they necessarily inflame. Mr. Ashberry's plan, the lecturer added, had this advantage—that a constant supply of air is admitted through slots in the furnace-door.—*Builder*, No. 640.

NEW WATER-WORKS AT HAMPTON.

By an Act passed in 1852, the Metropolitan Water Companies are compelled to make stated changes in the service and mode of supply within a certain limited period. The West Middlesex, the Grand Junction, and the Southwark and Vauxhall, have their new works contiguous to each other, on the north bank of the Thames, immediately above the village of Hampton, 22 miles above Vauxhall-bridge. From this point the water is brought by the Companies to their several works for deposit, filtration, and distribution by three great mains—two of 36 inches and one of 33 inches diameter. These mains are together capable of bringing 60,000,000 gallons in the twenty-four hours. The *Illustrated London News* gives a view of the works, and these particulars:—"As far as the village of Twickenham the mains lie side by side; there the Grand Junction main diverges through Isleworth and Brentford to the works of that company near Kew-bridge. The two other mains, after being taken under the bed of the Thames at Richmond, separate at Sheen. The West Middlesex main goes through Mortlake to their reservoirs of deposit and filtration at Barn Elms, on the Surrey bank, opposite to, and connected by a main under the Thames with, their works at Hammersmith. The Southwark and Vauxhall main continues through Putney and Wandsworth to the site of that company's works in the new park at Battersea. The length of the mains respectively is as follows:—The Southwark and Vauxhall, 13¼ miles, or 23,000 yards; the West Middlesex, 8¼ miles, or 15,000 yards; the Grand Junction, 7½ miles, or 13,500 yards. The aggregate area of the sites of the works of the three companies, at Kew-bridge, Hammersmith, and Barn Elms, and Battersea, is 120 acres. The reservoirs and filter-beds at the works of all the companies are completed. The engine and boiler houses at Hampton are roofed in, and ready to receive the machinery, a considerable portion of which is on the ground, and now fixing. The length of mains laid on is as follows:—The Southwark and Vauxhall Company, 12,500 yards; the West Middlesex Company, 14,500 yards; the Grand Junction Company, 7,500 yards. In this statement of the mains laid is comprehended the portion of the two 36-inch mains laid under the bed of the Thames at Richmond." The daily delivery of

water to London during the last few months, according to our authority, has fallen little short of 100,000,000 gallons.

THE NEW RIVER WATER.

A "REPORT to Mr. W. C. Mylne, on the quality of the New River Company's Water," by Mr. T. Spencer, F.C.S., in reference to an analysis by Dr. R. D. Thomson, alluded to in a recent report of the General Board of Health on the epidemic cholera of 1854, has just been printed. Mr. Mylne is the engineer of the New River Company, on whose behalf Mr. Spencer was employed to make new analyses, with the view of subverting those of Dr. Thomson, which alleged, inferred, or insinuated, the existence of two different qualities of water supplied by the New River Company, the one considerably more impure than the other, and probably promotive of cholera in the district (Soho) to which it was supplied. This the Company appears to deny, and Mr. Spencer's analyses to contradict; his conclusions being to the effect that the New River water is much the same as respects purity that it was in 1851, when examined by Professor Graham and other chemists. As Dr. Thomson, however, did not give that categorical information as to his analyses which Mr. Spencer demanded, but referred him to a second Report not then published, the latter has been unable to identify the precise source of the objectional water, as to which he considers that there must be some mistake, either in the analyses or in the fact or supposition of its being the New River water.—*Builder*, No. 657.

NEW FILTER.

MR. CHEAVIN, of Donington, near Spalding, Lincolnshire, has invented a Filter, with which he has proved before the City of London Commissioners that muddy, and even stinking water may be instantaneously made sweet, varying from 200 to 10,000 gallons daily. It is so simple in its construction that, if properly attended to, it will not get out of order for twenty years; whereas all others soon became useless by being choked up—to remove which difficulty, Mr. Cheavin's filter has a cylinder and blow-pipe attached to it. In the above trial, Mr. Cheavin produced a bucketful of water which, but half an hour before, had been taken from the Thames at Southwark-bridge. It was very filthy, and of a deep green colour, stinking exceedingly. To the evident surprise of the majority of the Commissioners present, the water, poured in at the top, instead of issuing in dribblets from the tap, as in the case of the ordinary filters, poured forth in an uninterrupted flow, perfectly pure and bright, until the filter was emptied.

SEWAGE OF LONDON.

MR. J. B. LAWES has read to the Society of Arts a paper on this subject, in which he first proceeded to point out what constitutes value in a manure, and next directed attention to the composition of Sewage. Considering that human excrements were the main items to be taken into calculation, he estimated the amounts of carbon and nitrogen consumed per day in the food of individuals of different classes, ages, and sexes; registered the amounts of carbon expired daily by the lungs;

and then quoted or calculated from various experimenters the amounts of solid and liquid excrements and the valuable constituents contained therein. Mr. Lawes calculated that the sewage of London, if entirely freed from water, would amount to 51,286¾ tons, of which about one-sixth was nitrogen, namely, 8859¾ tons, equal to 10,758¼ tons of ammonia. This is, however, unfortunately distributed through such a vast bulk of water, that the cost of its distribution would be enormous, whilst it was questionable how far it would be beneficial for corn crops. Various attempts have been made to solidify the sewage, but Mr. Lawes thinks that with our present knowledge the manufacture of a solid sewage manure is quite impracticable. He therefore recommended that a few thousand acres at no great distance from the Thames should be devoted to grass, as the most suitable crop for the application of liquid sewage, and this would return to the metropolis milk and cream, with which the inhabitants are at present most inadequately supplied. The discussion on this subject extended over two evenings, and was well sustained. There was universal agreement as to the desirableness of freeing the metropolis and the river Thames of the sewage, but great diversity of opinion was exhibited as to whether the cost of the collecting and distributing works would be realized; whether, in fact, the value of the article would repay the expenses incurred in pumping, &c.

APPLICATION OF LIQUID MANURE TO SUBSOILS AND ROOTS.

The result of Mr. Wilkins's plan adopted on some waste land at Wokingham, by way of experiment, for one year, has been published. The liquid manure was applied through semi-cylindrical tiles laid convex side up on a water-tight floor of brick, edged round with bricks 4½ inches high, and covered with soil to a depth of 18 inches, in which the crops were planted in lines running coincidently with the tiles. The same sorts of seeds were planted in duplicate on the same sort of soil, but without either the tile or brick apparatus. To the former, liquid manure was applied about twice a week; to the latter, none was given. The results were quite extraordinary, especially with mangel-wurzel and carrots. The mangel-wurzel was produced, with manure, at the rate of about sixty-nine tons per acre, the average weight of the roots being twelve pounds each, whereas on the unprepared piece it was four pounds, and on a piece of ground prepared with a top dressing of liquid manure, six pounds. Italian rye-grass was cut five times on the prepared bed to one cut on the other; the fifth of the former being exceedingly tender and juicy, while the one of the latter was tough and dry. Potatoes were doubled in weight by the manure. Hemp and flax grew luxuriantly by its aid. In three months the hemp was six feet long, and a second crop was then planted, which grew to the same length. Mr. Wilkins says, that even three crops, and for cattle, seven crops, annually, of the necessaries of life, might thus be produced. The cost of construction, however, is considerable. With bricks for floors, he estimates it at 100*l.* an acre, but with gas tar and sand, at 50*l.* There are other difficulties in the way of the application of this method on the large scale, but we think we can see how, by aid of steam-power and a circulating system of valved and perforated manure pipes, such

difficulties might be overcome, so far as inequalities of ground are concerned; whether to great profit remains as a further question.—*Builder*, No. 626.

SUGAR MANUFACTURE—CONCRETE CANE-JUICE.

Mr. W. A. Archbald, a practical planter, with the view of preventing the waste incurred by the present system of making cane-sugar, which exceeds one-half of the juice obtained from any given quantity of canes, has discovered a plan of importing the crops in the state of concentrated juice, or converting them into a new saccharine material, called Concrete Cane-juice. Some difference of opinion having arisen as to the practicability of making concrete from cane-juice, three important experiments have been made on canes imported from Demerara.

The result of the first experiment is declared to have been highly satisfactory. The concrete was made with the greatest facility, being of a handsome yellow colour, and became hard in less than half an hour. For the second experiment the canes were cut into lengths, split with a knife, and ground. They were by this time so decomposed, as to have become red, and emitted a strong odour, like that of decayed pine-apples. A sufficient quantity of juice was procured, by pressing the canes in a handmill. It was too nauseous to be drunk, owing to the fermentation that had taken place, and was of a dirty greyish white colour. The "Archbald ingredients" were added successively, and mixed up with it, which first changed the colour to a light straw, and then made it perfectly white and limpid, like filtered water. The whole process of subsidence did not occupy half an hour. The juice was now of an agreeable taste, and a quantity was poured into an iorn fish-kettle, and allowed to boil. This it did, with the greatest rapidity, without throwing up any scum whatever, and the evaporating process was continued until the thermometer indicated that the juice had attained the proper degree. It was then turned into convenient vessels and set to cool; but the article is not so good as that made on the former occasions, owing to the very bad condition of the canes.

These Experiments have established conclusively the following points:—

1. That the "Archbald ingredients" accomplish a perfect defecation, and that the formation of scum during the process of boiling cane-juice to the sugar-point is avoided. By this the waste of juice for sugar-making process—estimated by the late Dr. Shier, of Demerara, as not less than 20 per cent. on any given quantity in the clarifier—is entirely obviated, and the labour of the men employed in skimming under the ordinary process is economized.

2. That the portion of juice which is usually converted into molasses—varying from 40 to 55 per cent. on the quantity of sugar made in the ordinary way—is solidified, that is, converted into concrete. Hence, the waste on the estate, in various ways, before shipment, and that which occurs, during the transit across sea, and subsequently in the docks, amounting in the two latter cases to not less than 17 per cent., can be prevented.

3. That the whole of the juice daily obtained from any given quantity of canes may be made ready for shipment, in the state of concrete, within twenty-four hours after the latter have been cut—an advantage which the planter and the merchant will readily appreciate, for by the ordinary process it takes from a month to six weeks to make only about half of such quantity ready for shipment as sugar.

4. That cane-juice may be perfectly defecated and concrete made without new machinery, the process being quite simple.

These Experiments have also shown that, by the use of the "Archbald ingredients," cane-juice, though in a high state of fermentation, may be perfectly purified and rendered fit for conversion into sugar or into concrete. The canes in the present instance had been cut nearly two months, had been exposed to the heat of a ship's hold, and subsequently, in this country, to the deteriorating influences of exposure to atmospheric influence. It is well known that in the West Indies canes must be crushed as soon after they are cut as possible, as when they have been cut three days they either will not make any sugar at all, or they produce a material which is neither sugar nor molasses. At the end of a week they will not even produce this.

We understand that this new process has been introduced with success into the Mauritius. The following extract from a letter from that island, dated 13th January last, addressed to a merchant in London, shows that the ingredients are as easy of application for making sugar as for making concrete, on a manufacturing as they are on an experimental scale:—

"We succeeded in proving the efficacy of the ingredients in cleansing the juice, which the planter made into sugar, and we calculate the improvement in the quality equal to 3s. per cwt."

It may be observed, that in addition to the improved quality of the sugar, there is an extra gain in quantity of at least 30 per cent. On the other hand, the cost of the ingredients for making sugar amounts to not more, we are assured, than 7d. per cwt., and for concrete about 6d. per cwt., which cost is covered by a large economy in the current expenses of the estate, and in the saving of hogsheads, &c.

To the friends of the negro this important discovery recommends itself, chiefly because 100 labourers are made equal to 200, as they are enabled to obtain from any given quantity of canes double the amount of produce in a state of concrete that is obtainable under the system in actual use.—Abridged from the *Anti-Slavery Reporter*.

BEETROOT SUGAR.

M. Maumené has invented a new process of manufacturing Beetroot Sugar, by which the work may go on throughout the whole year, instead of for a limited period, as hitherto. His plan consists in extracting the juice from the beetroot, and immediately adding to it the proportion of lime sufficient to transform all the sugar into saccharate of lime, which may be afterwards used as required according to the usual processes.

EXPANDING PORTABLE BRIDGE.

At the Institution of Civil Engineers, Mr. Lavanchy has exhibited a model of an Expanding Portable Bridge of his invention. The system has been tried at Paris, where a bridge on this principle, fixed upon a boat in the canal, had been used for permitting the passage of troops; the boat yielded considerably to the weight of the men brought upon it, but the bridge remained stiff, and the commanding officer had reported well of its properties.

The principle was that of a number of strips of iron or wood, pinned together transversely at such points as that they should form a series of equilateral parallelograms, the extension being obtained by the motion upon the connecting pins, somewhat on the "lazy-tongs" principle. A bridge of this construction can be made very light for any moderate span, and be conveyed by a boat to be projected to both banks of a stream; be used for the centre, or any portion of a long floating bridge of boats; be carried upon a pair of wheels with a regiment, or used for numerous civil purposes; and its construction is stated to be not at all expensive.

THE DRAINAGE OF THE LAKE OF HAARLEM.*

M. D'Endegeest, President of the Commission for the Drainage of the Haarlem Lake, has published a final Report on the condition of the enterprise. The total expense of the undertaking, from 1839 to 1855 inclusive, has been 8,981,344 florins; the revenue proceeding from the land redeemed and sold is estimated at 8,000,000 florins. The land was at first valued at 200 florins per hectare (2471 English acres). But subsequent examination proved that the soil laid bare by the draining operations was of far greater value than was originally supposed. Thus in 1853, 784 hectares brought 575,000 florins, or 733 florins per hectare; and though subsequent sales have not realized such large prices, yet the land commanded a much higher price than the first valuation. "This result," says M. D'Endegeest, "surpassed all expectation, inasmuch as the grand object of the drainage was rather to put an end to the encroachments of the lake, than to make a lucrative speculation of it." It is stated that a great number of farms are springing up on all sides, and that the cultivation of the rich land is affording employment to many hundreds of labourers. The total amount of land available for agriculture is estimated at 18,000 hectares; and by proper care and supervision it is confidently expected that no water-overflows will take place.

ATTEMPT TO SOUND NIAGARA FALLS.

The person who has been making the experiment of sounding the river below Niagara Falls, writes as follows:—"Another attempt was made with a similar iron of about 40 lb. weight, attached to a No. 11 wire, all freely suspended, so as not to impede the fall of the weight. I then let the weight fall from the bridge, a height of 225 feet. It struck the surface fairly, with the point down—must have sunk to some depth, but was not longer out of sight than about one second, when it made its appearance again on the surface, about 100 feet down the stream, and skipped along like a chip, until it was checked by the wire. We then commenced hauling in slowly, which made the iron bound like a ball, when a cake of ice struck it, and ended the sport. I am satisfied that no metal has sufficient specific gravity to pierce that current, even with a momentum acquired by a fall of 225 feet. The velocity of the iron when striking must have been equal to 124 feet per second; and, consequently, its momentum near 5000 lb. Its surface

* See the works described in the *Year-Book of Facts*, 1847.

opposed to the current was about 50 superficial inches. This will give an idea of the strength of that current, and at the same time hint at the Titan forces that have been at work to scoop out the bed of the Niagara river."

PROPOSED SUBMARINE RAILWAY TUNNEL FROM ENGLAND TO FRANCE.

ANOTHER new form of this project has been sketched out by Mr. James Wylson, C.E., in the *Illustrated London News*. Mr. Wylson preludes his own modification of the tunnel by a brief historical record of the various forms under which it has been suggested, and points out the *Builder's* early connexion with the project. The names associated successively with it in this sketch are, Mr. Rettie, of Glasgow, C.E., in 1838; Mr. De la Haye, of Liverpool, in 1845; Mr. E. Pearse, of Tavistock, in 1846; M. Ferdinand, in 1848; M. Horeau, in 1851; and Dr. Payerne and M. Favre, in 1855. Mr. Wylson's peculiar modification of the idea consists mainly in the submersion, midway or more towards the bottom of the channel, of a tunnel built on pontoons at the surface, and constructed in a way analogous to that pursued in the cooper's craft; the tube being cylindrical, and consisting of a system of staves and hoops of wrought-iron, with some flexible and saturated sheeting between the two, and lined interiorly with dowelled brick, to moderate the buoyancy of the whole, and steady it *in situ* below the field of storm-wave commotion altogether, where it would be moored by weights of sufficient ponderosity after being sunk to its position. The ends of the tunnel would be closed each with a hemisphere of iron, and access be had from above the surface of the water by shafting and platforms, so that the whole would float freely without any rigid attachment to the shores. There might also be shafts for ventilation here and there along the line, with bells and lights to indicate the whereabouts of the tunnel to vessels passing it; and the tunnel might be lighted by electricity, the tops and sides of the carriages being of glass. Mr. Wylson provides for various other contingencies into which we cannot enter. He estimates the total cost of his project, so far as regards the tube itself, at 15,000,000*l*., or 750,000*l*. a mile; the tube being suitable to a single line only, to be worked alternately to and fro. This estimate, as he remarks, is about two and a half times the cost of the London and Blackwall Railway. Mr. Wylson's object is merely to indicate the practicability of the project, and advance it a stage or so towards its possible future realization.—*Builder*, No. 669.

For several weeks some able hydrographers and engineers have been employed surveying the coasts in the neighbourhood of Boulogne and Calais on the French side, and of Dover and the South Foreland on the English side, of the Channel; as well as in taking soundings, with a view of reporting as to the feasibility and advantage of forming a communication between the two countries by means of a submarine tunnel and railway. M. L. Favre (Niort, department of Deux Sevres), the distinguished French engineer, has published the details of his extraordinary scheme. He says:—"Our project consists in a tunnel formed under the sea, and offering as much security as a railway under the open sky. The tunnel will be pierced in a manner so that the bed of the earth which

will divide it from the sea will never be less than 25 metres even at the greatest depth of the straits. The tunnel will be lined with a double arch, the first to be of granite and of impermeable cement, the second of thin iron plate, pierced in different places, in order to discover immediately the least filtration." The estimate of the cost is 100 million of francs. As to the choice of the line, the engineer discusses several routes, but gives the preference to the first-named :—From Cape Gris Nez to Dover, in a direct line; from Cape Gris Nez to Dover, touching the bank of Varne; from Cape Blanc Nez to the Foreland; from the village of Sanzatte to the Foreland. He says the soundings, which have been made with great care, show us that we shall meet a rock, which will enable us to establish a tunnel of very great solidity. The earth itself will form a natural vault of freestone, which will tend to prevent any filtrations. The system of traction proposed for the railway is the atmospheric, by which it is estimated the journey between France and England will be performed in twenty-five minutes!

SINCLAIR'S WATER-ENGINE.

THE *Dundee Advertiser* speaks in high terms of a Water-engine put up for the writer by Mr. Sinclair, of Stirling; and which, at an outlay of only one-half of what would be required for a steam-engine of equal power, gives twenty impressions in the minute, or 1200 in the hour. Notwithstanding the high speed which this water-engine gives—as high as the press can be safely worked—the engine itself is in size little more than a toy, weighing less than a hundredth-part of the machine it works, and standing on no more space than would be required for a small box, and on one-fourth of that required for the working of the ordinary fly-wheel. The size of the sole-plate on which the engine stands is only eighteen inches by twenty-two inches; the cylinders are only two and a half inches in diameter, with five inches length of stroke, and the top of the driving-pulley is under thirty-six inches from the floor. The economy of space and power which it accomplishes depends upon the valves of the cylinder working on the pivots of oscillation, and on the fact that each cylinder is double, and gives twice the power of cylinders of the same size in the ordinary water-engines. It is thought that while this engine answers so well for the purposes wherever pressure of water can be had at moderate rates, it will be equally available for numerous purposes in which a moderate or even a high speed without great power may be necessary. With a reservoir at an elevation of four hundred feet, a pipe discharging only eight gallons per minute, will give one-horse power.

WATER SUPPLY OF LONDON.

The following views and papers have been produced upon this important inquiry:—

"At the Institution of Civil Engineers, two evenings have been devoted to the discussion of Mr. P. W. Barlow's Paper, 'On some peculiar Features of the Water-bearing Strata of the London Basin.' It was contended that the sands underlying the chalk would be found the most certain sources of water supply. The conditions of the strata

at Grimsby were different from those of the London basin; and in the latter locality, some years ago, in any well of moderate depth, water was certainly met with; whereas, at present it was only found at considerable depths, and was only obtainable by great pumping power. The water was now chiefly found in the fissures and flint beds, and but little in the solid chalk, beyond that held in suspension, and which it was difficult to extract. Water might be found in sufficient quantity, in the chalk, for the supply of two or three suburban parishes near the metropolis, but the conditions were very different from those of London itself; and it was strongly contended that it was illusory to trust to any such source for a large supply by Artesian wells. It was admitted that water was obtainable from chalk, chiefly, if not entirely, by infiltration through the fissures and the layers of flints; and that, although chalk was a rapid absorbent of moisture, it did not readily part with it again; nor in its normal condition would it afford a free passage for water, therefore it could not be correctly denominated a water-bearing stratum; whereas sand could be correctly so termed. The chalk was, however, in certain districts, so intersected by fissures, and had such numerous layers of flint, that practically the effect of a water-bearing stratum was obtained; hence the excessive pumping from one well would affect all around, as also the sources of the streams. Sand was, on the contrary, essentially a water-bearing stratum; the facility of yielding moisture depending generally on the size, and therefore the collective compactness or openness of the grains. It was as susceptible of saturation as the chalk; but not as capable of retention of moisture. In some districts, the lower tertiary sands were mixed with clay, which interrupted the flow of water, whilst in others, they afforded a free passage. It was mentioned that the lower green sand stratum had been reached in the Hampstead well, at a depth of 1150 feet from the surface; and a very short time would now demonstrate the correctness or the fallacy of the views, as to the quantity of water to be obtained from these strata. The wells under London do not now yield more than eight millions of gallons per day, and the water-level has been gradually sinking. In the year 1824, the water, when not affected by pumping, rose to within ten feet of high-water mark, but now it does not reach to within sixty feet of the same level.

At the Royal Institution, Mr. Dickinson, F.R.S., has delivered a Lecture on the Water Supply, developing his own plan, which is partly based, it would seem, on a proposal, made in 1641, to convey water from Rickmansworth; and another, by Mr. White, in the year 1788, to construct an aqueduct for the conveyance of water from Harefield, in Middlesex, to the north side of Portland-place. Mr. Dickinson proposes to take his supply from the river Colne, which has hitherto (he observed) been unaccountably neglected. This river is much higher than the level of the Lea; and its chemical constituencies, which are pretty nearly similar to those of that river, may be pronounced innocuous. It is the opinion of the lecturer that a large supply of very—if not perfectly—pure water may be supplied from the Colne, by the principle of gravitation, to the inhabitants of Kensington, Fulham,

Knightsbridge, Brompton, Belgravia, and a great part of London. It is proposed to convey the water by means of an aqueduct to a large reservoir at Kilburn, at 180 feet above the Ordnance *datum;* here it will be filtered, and hence it may be delivered, by a pressure of 10 feet, to houses on the low level of Westminster, Belgravia, &c., at a high service of 40 feet above the pavement, so that water may be supplied at all times at high service. The aqueduct is to be a reservoir of moving water, well guarded by gratings, and carefully secluded from trees and the possible infusion of vegetable matter.

Mr. S. C. Homersham has communicated to the Society of Arts a paper on the "Chalk Strata considered as a Source for the Supply of Water to the Metropolis." In many districts of Great Britain, where the soil rests on impermeable strata, the water that falls flows off by means of rivers, canals, brooks, and streams, and is collected in reservoirs, and used for supplying towns. On the other hand, where the soil rests upon chalk, as on the Chiltern hills and the North Downs, the water sinks into the earth, and goes to supply subterranean reservoirs, flowing from thence through the interstices in the planes of stratification into the sea. The proposal of Mr. Homersham is, that before the water reaches the sea, it should be intercepted for the supply of the metropolis. The only drawback to the use of this water is, that it contains about seventeen and a half grains of bi-carbonate of lime per gallon; but this, by the softening process of Dr. T. Clark, of Aberdeen, which was described, may be precipitated. In the discussion, objection was taken by Mr. F. Braithwaite, the Rev. J. C. Clutterbuck, and Mr. Evans, as to the quantity of the water to be derived from this source; and Mr. Braithwaite took exceptions to its quality, on the ground that the water of the deep wells under London was becoming salter and salter every year, showing that there must be an infiltration of salt or brackish water into the so-called London basin. To this, it has since been replied, that though the presence of salts in the water in question cannot be denied, yet they are becoming less and less in quantity year by year; and their presence at all is to be accounted for, not by any supposed infiltration of sea-water, but rather by the fact that the chalk being a marine formation, contains within itself a large per centage of salts, which are gradually being washed out; and that this will explain how it comes to pass that they are less in quantity in water obtained from wells in the higher districts of the chalk, than in that derived from the low-lying beds.

NATURE PRINTING.

Mr. Henry Bradbury has delivered at the Royal Institution an elaborate lecture upon Nature-Printing, which is thus termed from Nature herself, in her mysterious operations, seeming to have given the first hint upon the subject: witness the impressions of ferns so beautifully and accurately to be seen in the coal-formations. Experiments to print direct from nature were made as far back as about 250 years: it is certain that the present success of the art is mainly attributable to the general advance of science, and the perfection to which it has been brought in particular instances.

Passing over a great deal of intervening ground, we come to Mr. Bradbury's conclusion and summary:—"The first practical application of Nature-Printing for illustrating a botanical work, and which has been attended with considerable success, is Chevalier Von Heufler's work on the *Mosses collected from the Valley of Arpasch, in Transylvania;* the second (the first in this country), is the *Ferns of Great Britain and Ireland*, in course of publication, under the editorship of Dr. Lindley, and printed by Messrs. Bradbury and Evans. Ferns, by their peculiar structure and general flatness, are especially adapted to develop the capabilities of the process; and there is no race of plants where minute accuracy in delineation is of more vital importance than the ferns, in the distinction of which, the form of indentations, general outline, the exact manner in which repeated subdivision is effected, and most especially the distribution of veins scarcely visible to the naked eye, play the most important part. To express such facts with the necessary accuracy, the art of a Talbot or a Daguerre would have been insufficient until Nature-Printing was brought to its present state of perfection." Mr. Bradbury then adverted to the ingenious and beautiful productions of Felix Abate, of Naples. His Nature-representations consist of sections of wood, in which the grain is admirably represented. He terms his peculiar process Thermography, or the Art of Printing by Heat. The process consists in wetting slightly the surface of the wood of which fac-similes are to be made, with any diluted acid or alkali, and then taking an impression upon paper, or calico, or white wood: the impression is quite invisible, but by exposing it for a few instants to a strong heat, the impression appears in a more or less deep tone, according to the strength of the acid or alkali. In this way every gradation of brown from maple to walnut is produced; but for some woods which have a peculiar colour, the paper, &c., is to be coloured, either before or after the impression, according to the lightest shades of the wood. Abate, in his manipulations, also employs the ordinary dyeing process; it is hoped that his process may become alike useful to the natural sciences and the decorative arts.

Mr. Bradbury stated, in conclusion, that we are indebted to—Kniphof, for the application of the process in its rude state; Kyhl, for having first made use of steel rollers; Branson, for the suggestion of the electrotype; Leydolt, for the remarkable results he obtained in the representation of flat objects of mineralogy, such as agates, fossils, and petrifications; Haidinger, for having promptly suggested the impression of a plant into a plate of metal at the very time the *modus operandi* had been provided; Abate, for its application to the representation of different sorts of ornamental woods on woven fabrics, paper, and plain wood; Worring, of the Imperial Printing Office, Vienna, for his practical services in carrying out the plans of Leydolt and Haidinger. Nature-Printing may be considered as still in its infancy; but the results already obtained in its application encourage us to expect from continued efforts such further improvements as will place it not least among the Printing Arts.—Abridged from the *Athenæum*, No. 1442. See also the entire Lecture, which has been published.

IMPROVED PORTABLE COPYING PRESS.

Messrs. S. Mordan and Co. have issued an improved Portable Apparatus for Copying letters, &c., patented by Mr. Terry, of Adelphi-terrace. The object of the invention is to combine with the covers of a book a suitable apparatus in such manner that the act of closing the covers shall be the means of copying documents inserted between the leaves of the book. The invention is carried out by affixing to the outside of each of the covers a rigid metallic frame; that on one cover carrying an inclined projecting piece at each end, and that on the other having hinged to each end of it one or two links which, when the book is closed, are pressed by hand over the inclined projecting pieces, so as to tightly compress the leaves of the book, and hold them in a compressed state as long as is desirable. Each of the frames is composed of one thin longitudinal plate, crossed by three transverse plates of the same thickness, the necessary strength and rigidity being supplied by means of ribs formed upon the plates.

NEW AMERICAN POLYCHROMATIC PRESS.

Mr. S. Brown, of Syracuse, New York, United States, has invented a Printing-press of novel construction. It is capable of working off five hundred impressions per hour, in four colours, and one thousand impressions per hour on book work and plain jobbing. When printing in colours, its superiority consists in all the colours being worked at one impression; and it can be so arranged as to print shaded letters; or a border can be worked all round a job in one colour, at the same time that the body of the form is of *different* colours. This is a desideratum in printing, and an immense advantage over the present plan of printing each colour in a separate impression. The inventor also thinks that the principle can be applied to calico printing; and if so, of course the invention would be invaluable in England, as it would save engraving, and the same materials could be used on different patterns of goods, on the plan of a combination border.—*Mechanics' Magazine*, No. 1652.

INDESTRUCTIBLE PRINTING OF METALLIC PLATES.

Messrs. Adams and Gee, printers, of Cloth Fair, have found that Metallic Plates, of the thickness of ordinary sheet-tin, may be printed upon with the usual printing type, if the plates be first coated with a whitish composition—the secret of the inventors. If sheets thus printed upon be afterwards subjected to a certain japanning process, an even lustrous surface is produced, which cannot be acted upon except by a sharp steel instrument. The cost of preparing the printed sheets is small.

Printed metallic sheets of the above description may be substituted with great advantage for the mounted paper lessons employed for class teaching in schools, which, from the rapidity with which they become worn, are costly apparatus in public educational establishments.

This improvement originated with Dr. Lhotsky, the clever linguist.

ADHESIVE STAMP APPARATUS.

Mr. David Bogue, of Fleet-street (publisher of the present volume), has patented an Improved Apparatus for facilitating the attachment of Adhesive Stamps.

The stamps or labels when cut up are arranged in a pile and placed in a box, the sides of which are formed of four vertical plates, hinged to a fixed bottom plate. These hinged plates are kept in a vertical position, by means of bow strings affixed to the bottom of the box; and their upper edges are bent over outwards, to permit of the sides of the box yielding when pressed upon vertically by the descent of the damped paper, which is to be brought down upon the upper stamp.

NEW RAW MATERIALS FOR PAPER.

We have abstained from all mention of the process for which a patent was granted to Messrs. Charles Watt and Hugh Burgess in August, 1853, until the experiments made with the view of testing its merits, and bringing it to absolute perfection, had arrived at such a point as would enable us to say that the process had succeeded completely.

These experiments have been performed on a very extensive scale in the United States and in England, and the result is that pulp for paper can be produced, of first-rate quality, at a cost which will cause it to become a most economical substitute for rags.

The paper difficulty may now be regarded as at an end, since the supply of wood is constant, and so large as to render it certain that no deficiency in the supply of the material for paper can again arise.

The process consists in first boiling the wood in caustic soda ley, in order to move the resinous matter, and then washing it to remove the alkali; the wood is next treated with chlorine gas, or an oxygenous compound of chlorine in a suitable apparatus, and washed to free it from the hydrochloric acid formed; it is next treated with a small quantity of caustic soda, which converts it instantly into pulp, which has only to be washed and bleached, when it will merely require to be beaten for an hour or an hour and a half in the ordinary beating-engine, and made into paper.

This process occupies only a few hours; in fact, a piece of wood may be converted into paper and printed upon within twenty-four hours.—*Chemist.*

Mr. Predaval Bartholomew, of Great Russell-street, Bedford-square, civil engineer, has patented a means of "improving the production and manufacture of pulp for the making of paper." This invention consists in the manufacture of pulp from vegetable fibres, such as those of the willow, mulberry, and other trees, &c., by cutting them into pieces of about three inches in length, pounding, bruising, grinding, or triturating them, and then winnowing them so as to separate the parts according to their sizes and relative weights. These processes are effected by means of a machine constructed by the inventor for the purpose.

Mr. R. A. Brooman, of 166, Fleet-street, has patented "a means of preparing the fibres of certain plants of the bean species, in order to form them into pulp, and to fit them for manufacturing purposes." This invention relates to plants of the description known as French

beans, scarlet-runners, &c. The plants are first boiled, then allowed to drain, and afterwards subjected to strong pressure. They are next again boiled, and removed to a rubbing machine, in which the parts of the plants are rubbed together until dry, in which state the fibres are separated from the coarser parts by a scutching machine. The coarser parts are then reduced by boiling to a pulp fit for the manufacture of paper, while the other fibres may be employed for various manufacturing purposes.

A number of an American paper, called the *Albany Journal*, has been printed on paper made from basswood shavings of a peculiar form, thrown off by a machine called Beardslee's planing-machine. The quality is described as good, and even fit for the transfer of line engravings. The pulp is said to be cheaply manufactured by a simple but secret process, applicable to different kinds of wood shavings.

PAPER-MAKING MACHINERY.

MR. JOSEPH FOURDRINIER, of Sherbourne-street, Islington, has patented certain "improvements in Machinery for washing, boiling, cleaning, and bleaching Rags, fibrous and textile substances." This invention consists in constructing a vessel closed at each end and mounted on hollow axles. On the interior, near each end, is fixed a sieve of fine wire-cloth or other suitable material. The vessel is provided with manholes for charging and discharging the materials, and to the two hollow axles of the vessel a pipe with branches is connected, by which water or washing or dyeing liquids can be caused to flow in one end, and away at the other. In the interior of the vessel are a number of spheres, which, by the rotation of the vessel, cause the matters under process to be beaten and pressed. Steam pipes or a steam jacket, or both, are used for causing the fluids to boil.

SILK AND PAPER FROM THE MULBERRY-TREE.

SIGNOR LOTTERI has proved, by careful experiment, that the bark of the common Mulberry-tree (Morus Alba et Nigra), hitherto known and used, in its primitive state, only as a combustible, has been found capable of producing a material of a silky substance, valuable not only for the reel and the loom, but likewise in a still higher degree for the manufacture of paper of the finest description; and, moreover, that it can be prepared for both these purposes by the very simple and economical process of maceration. Thus, we are informed, the biennial pruning of the thirty-six millions of mulberry-trees which, according to the most accurate statistics, it is calculated are cultivated in Europe and its colonies for the purpose of rearing the silkworm, may be made to yield to commerce, over and above the 200,000,000 of pounds of fuel, for which purpose solely it is used, an immense supply of raw material for paper-making.

The Secretary of the Malta Society of Arts has forwarded to the Society of Arts in London a specimen of the result of Signor Lotteri's labours in a series of stages—from the twig of the mulberry-tree to the silky material prepared for the spinner or the paper-maker.

STRAW PAPER.*

MR. LOUIS V. HELIN, chemist, of Brussels, has devised certain improvements in the Manufacture of Paper from Straw. In carrying out this invention the straw is steeped in water, then washed, then rolled, or acted upon by millstones, and then dried. It is afterwards steeped in alkaline solutions of soda or potash, exposed to air, and then subjected to one or more of the following baths:—First, of carbonate of soda or of potash 8 lbs., and water 20 gallons. Second, of bicarbonate of soda or of potash 6 lbs., and water 20 gallons. Third, caustic potash or soda 4 lbs., and water 20 gallons. Fourth, hypochloride of potash or of soda 10 lbs., and water 20 gallons. Fifth, hypochloride of lime or bleaching powder $1\frac{1}{2}$ lbs., water 20 gallons, to which may be added in addition, if necessary, $1\frac{1}{4}$ lbs. of bleaching powder.—*Mechanics' Magazine*, No. 1658.

THE SILKWORM.

A PAPER has been read to the Society of Arts, on "The Commercial Consideration of the Silkworm and its Products," by Mr. Thomas Dickens. Though this manufacture engages perhaps fifty millions of our capital, and employs about one million of our population, and though the worm has given us the most perfect and most beautiful of all fibres, each worm affording about five hundred or six hundred yards of usable quality; yet, owing to the defective process of the first operation, we have a raw material so comparatively imperfect, that no industry or skill can well remedy the defects, differing in this respect from other fibrous materials, as cotton, wool, flax. It has, indeed, been asserted in the reeling districts of France and Italy, that the cocoons cannot be transported from one country to another; that a southern climate is most essential; that reeling cannot be properly carried on in wet or damp weather; and that even a cloudy day affects the quality of the silk. But, by a new process, the invention of Mr. John Chadwick, of Manchester, and the practical development of which is due to the author, two or three of the usual operations in silk-winding and throwing are dispensed with. The cocoons are softened and prepared as usual, and any required quantity reeled together; but instead of winding the silk at excessive speed, and consequently with much tension, into hanks, it is wound direct and slowly to the bobbins, and any amount of spin that may be required is imparted in its course thither. The combined thread very seldom breaks in its course to the bobbin, the separate filaments only occasionally; but as the cocoons successively fail or are wound off, they are replaced, the filament of the new cocoons attaching directly to the others, and being at the same time incorporated with them by the continuous spin. The thread, being thus maintained in its strength and size by placing in the new filaments, as needed, is free from all the knots at present inevitable in raw silk-winding. The loose hank of raw silk is thus dispensed

* Straw paper is by no means a novelty; for in a Catalogue of Curious Old Books, on sale by Waller and Son, 188, Fleet-street, we find *An Historical Account of Substances used in Paper-making*, London, 1800, "printed on the first useful paper manufactured solely from straw."

with, and the thread is spun at the same time that it is reeled. By this process there is a more complete extraction of the silk from the cocoon, a greater amount of tenacity and elasticity in the thread, a freedom from knots, and a saving of several shillings per pound with a superior quality. It has been shown in Cornwall by Mr. J. Hodson, that very excellent silk might be produced in this country: he gives the preference to the common black mulberry, as being the most hardy, and therefore the most suitable to our climate. After the reading of the paper, Mr. P. Le Neve Foster (the Secretary) gave a summary of the information received through his Excellency Sir William Reid, the Governor of Malta, in reference to the culture of the *Bombyx cynthia*, or Eria silkworm of Assam, in that island. This worm, it appears, will feed equally well on five vegetable substances—the castor-oil plant, the mulberry, the lettuce, the willow, and the wild chicory. It has been successfully reproduced not only in Malta, but in Turin, and also in Granada and the West Indies.

NEW MODE OF TRANSPLANTING TREES.

Mr. Barron has invented for this purpose a machine which resembles the common tumbrils for the conveyance of large pieces of timber, with the exception that the load is carried in a perpendicular position, and, while in motion, oscillates in the same manner as the suspended candlesticks in the cabin of a ship—instead of hanging horizontally between the wheels. Four wheels of large diameter support an oblong stage formed of beams of timber strongly knitted together. Two sets of these beams run lengthwise, parallel with each other, there being an interval of about 2 feet 6 inches in width between each set. These are firmly bound together at each extremity, by another system of beams resting on the axletree of each pair of wheels, so that an opening of a rectangular parallelogram shape is formed in the centre of the stage. When it is proposed to remove a tree, this framework is wheeled up to it, and the transverse bars in front having been temporarily detached, the trunk of the tree is placed within the parallelogram. A square trench—or rather, four trenches of equal length, and at right angles to each other—are then dug, beyond the limit of the roots, and of a depth corresponding to their width. When this is accomplished, the tree is by degrees undermined, and strong planks of deal are, during the progress of that operation, driven from trench to trench, underneath the mass of clay which they enclose. The heads of these planks have chains attached to them, and these again are connected with powerful jacks—screws acting on the same principle of combination as the common patent corkscrew—placed on the stage of the framework, and by the agency of these the whole mass is raised above the level of the earth's surface, when the void occasioned by its removal is filled up, and the way made firm for the passage of the hinder wheels across the chasm. A team of horses is next yoked to the machine, and these transport the tree to the site prepared for its reception, into which it is slowly lowered, and thus the operation is completed.—*Athenæum*, No. 1456.

ARTIFICIAL COMPRESSED INDURATED STONE.

A PATENT has been granted to the Indurated Stone Company for securing to them the right of manufacturing a new kind of "Artificial Stone, and of giving colour to the same."

The composition, or stone, is made by combining either sand, loam, chalk, gravel, shingle, plaster, cement, lime, or other friable and loose substances, with certain resinous and bituminous materials, which, by being compressed when in a warm and plastic state, can be moulded into any and every form that can be desired. One of the greatest advantages of the process is, that any colour can be incorporated; and the light and dazzling Bath stone can be imitated as readily as a grey slate, a red granite, or a black marble. It is almost impossible to tell the real from the artificial stone, as the latter possesses all the hardness and appearance of the former. It has, moreover, a qualification often much wanted in stones; it is quite impervious, and water cannot possibly penetrate it. For all purposes connected with water-works, such as reservoirs, harbours, piers, and the like, this quality will render it invaluable. It is readily manufactured, and can be made in any locality where one or all of the above materials exist; the finest sand or the roughest shingle will equally answer for its manufacture—though the sand will, of course, make the smoothest stone. As the composition is moulded, all fancy articles, such as corbels, brackets, capitals, and the like, can be produced at a cost which will be trifling in comparison with carved stone: the only expense in the first instance is a mould; and when that is procured, any quantity can be cast in it. We are informed that the average cost of the material is about 8d. per foot cube. This artificial stone will be particularly valuable in those parts of the kingdom where hard stone does not exist; and on the sea coast, and other places wherein shingle and sand abound.—*Land and Building News*, No. 41.

THE NEW READING ROOM AT THE BRITISH MUSEUM.

WE quote the following from the *Builder*, No. 633:—The plan which offered the greatest facilities was one for building in the quadrangle of the Museum a reading-room, with additional libraries round it, clear space being reserved all round for giving light and air to the existing buildings. This plan had the advantage of involving the purchase of no new ground; and, being absolutely out of sight, it spared the necessity of any expense in exterior architecture.

This arrangement was finally adopted. Mr. S. Smirke was authorized to obtain tenders, and a contract was entered into for the execution of the whole work by Messrs. Baker and Fielder, for about 100,000*l.*

The new reading-room is a circular apartment, 140 feet diameter, and 106 feet high, lighted by twenty windows, at the springing of the dome, and by a glazed aperture in the crown of it, 40 feet in diameter. The superintendent will sit on a raised platform in the centre, and be surrounded by two concentric ranges of table cases, for catalogues, &c. The tables for readers radiate from these as a centre, a small segment of the circle being partitioned off to give free access for the

attendants going to and from the library, and for the temporary deposit of books *in transitu*. Allowing upwards of 4 feet for each reader, there will be room for 336 readers. The cubic content of air within this room is about 1¼ million of cubic feet, and this ample volume of air will be constantly and gradually renewed by a provision for summer and winter ventilation.

Between the entrance-hall and the reading-room are the cloak-rooms and other offices; the whole of the remainder of the new building being appropriated to the reception of upwards of a million volumes of books. The book-cases are of wrought-iron, and in the construction of the libraries and of the central dome, bricks and iron are exclusively used. The dome will be covered with copper. The galleries in the reading-room will be of slate; those throughout the rest of the new building, of perforated cast-iron. The decorations will be painted. It is proposed to introduce a series of statues around the room, at the springing of the dome.

The new reading-room will be the largest, and may be made the handsomest in the world. Its position in the quadrangle allows immediate access from the hall, through which readers will proceed to the reading-room, from the king's library, and from the library in the north wing of the building.

INSTITUTION OF CIVIL ENGINEERS.

On November 20, the Council of the Institution awarded the following premiums:—Telford Medals to Mr. James Barton, for his paper "On the Economic Distribution of Material in the Sides, or Vertical Portion of Wrought-Iron Beams;" to Mr. E. E. Allen, for his paper "On Steam and Sailing Colliers, and the various Modes of Ballasting;" to Mr. R. A. Robinson, for his paper "On the Application of the Screw Propeller to the larger class of Sailing Vessels;" and to Mr. J. Phillips, for his "Description of the Iron Roof, in one span, over the Joint Railway Station, Birmingham." Council Premiums of books, suitably bound and inscribed, to Mr. J. Leslie, for his paper "On the Flow of Water through Pipes and Orifices;" to Mr. P. W. Barlow, for his paper "On some peculiar features of the Water-bearing Strata of the London Basin;" to Mr. J. Brunlees, for his "Description of the Sea Embankments across the Estuaries Kent and Leven, in Morecambe Bay, for the Ulverstone and Lancaster Railway;" to Mr. F. Braithwaite, for his paper "On the Infiltration of Salt Water to the Springs of Wells under London and Liverpool;" to Mr. G. J. Munday, for his "Description of the Coffer Dams used in laying the lines of Water-pipes, from Richmond to Twickenham, across the Thames;" and to Mr. L. E. Fletcher, for his "Description of the Landore Viaduct, on the South Wales Railway."

MUSICAL AUTOMATA.

Herr Maelzel, the famous musical machanician, died in the autumn of the past year. In a *tranchant* memoir of the poor inventor, in the *Athenæum*, No. 1458, we find the following details:—"In elder times, Maelzel might possibly have become a famous organ-

builder; but in our century he contented himself with putting together and perfecting sundry musical *automata*. The most famous among these, perhaps, was the *Panharmonica*—an automaton band of forty-two wind instruments, for which Cherubini deigned to compose; in this following the precedent set by Mozart, whose well-known pianoforte duett in F minor was originally written for a musical clock. For the same machine of machines, Beethoven wrote the *Battle Symphony*. The *Panharmonica*, after having been for many years exhibited in Europe, was sold to America, where it possibly still exists. In England, Maelzel will be especially remembered by his automaton Trumpeter, which used to travel in company with De Kempelen's automaton Chess-player; but best of all, by the Metronome. M. Fétis reminds us, that the original idea of this useful machine, as it stands, was derived from one Winkel, of Amsterdam; and that Maelzel, whose skill lay in suggestion, rather than calculation, did little but arrange and render practicable the Dutch mechanician's invention. As a man, Maelzel seems to have been quarrelsome, extravagant, and unscrupulous. He can only be ranked amongst those empirics whose cleverness almost amounts to genius. Had he possessed a larger amount of culture and of conscience, he might have done service to high Art."

A STEAM ORGAN.

In the *New York Musical Gazette* has appeared the following account of an invention by Joshua C. Stoddart, of Worcester, Massachusetts:—

The instrument is of simple construction, and consists of a horizontal steam-chest or cylinder, some six feet in length, and from four to six feet in diameter, which is fed with steam from the large boiler in the establishment where it is located. Upon the top of this cylinder is a series of valve-chambers, placed at equal distances from each other, into which the steam is admitted without obstruction. Each valve-chamber contains a double metallic valve, with no packing, yet it fits so closely upon its seat as to allow no steam to escape. To each of these valves is connected a very small piston-rod or stem, which passes through the chamber, and is operated upon by machinery without. Were it not for this stem, the valve would be simply a double balance-valve, and would remain stationary wherever placed, the pressure of steam being equal on all sides; but a part of one end of the valves being carried outside of the chamber gives it the self-closing power, which is the nicest part of the whole invention, and perhaps the best patentable feature. With a slight pressure against these rods, the valve is opened; and when the pressure is removed, it closes as quick as steam can act, which is not much behind electricity. Directly over each of these valves is placed a common alarm whistle, constructed similar to those used upon locomotives, except that it admits of being raised or lowered, to flatten or sharpen the tone. These whistles are made of different sizes, so as to produce the desired tone corresponding with each note, &c. This completes the machine, with the exception of a cylinder similar to those used in a common hand-organ or music-box, containing cogs which, when properly arranged, will, when turned by hand or otherwise, operate upon the valves in such a manner as to play any tune desired by simply changing the position of the cogs, which are intended to be moveable. One of these instruments can be heard from ten to twenty-five miles on the water, and every note will be perfect and full. We heard the inventor play *Rosalie* on it, and it looked like "getting off tall notes" mechanically. This invention is so completely under the control of the operator, that, were it arranged with a key-board similar to a piano, it would obey the slightest touch, and a child could play slow or quick tunes, every note of which might be heard several miles. It is the design of the inventor to place these instruments upon locomotives and steam-boats.

FLOATING FLOUR MILLS AND BAKERY FOR THE ARMY.

MESSRS. FAIRBAIRN AND SONS have, in two months, converted her Majesty's ship *Bruiser* into a complete Flour Mill, capable of grinding from 700 to 800 bushels of wheat *per diem;* taking the raw material in at one end of the vessel in the form of wheat, and turning it out at the other in well-manufactured flour, without the intervention of manual labour. The machinery is both ingenious and compact, and in moderate weather may be worked without suspending the progress of the vessel, notwithstanding it is all driven by the marine engine. The *Abundance*, a companion vessel, has in like manner been fitted up as a large bakery by Messrs. Swaine and Bovill, of Millwall, and is capable of turning out 20,000lbs. of bread *per diem*, with the aid of some very simple machinery. The bakehouse in this vessel possesses the great advantage of thorough ventilation, the hot air being withdrawn at pleasure by mechanical means, and as often replaced by fresh, which, in a warm climate, is an important consideration. The service owes this undertaking to Mr. Julyan, an officer of the Commissariat, who originated the scheme, and has carried it out to completion.

THE CITY FLOUR MILL.*

MESSRS. WHITE, PONSFORD, AND CO., have introduced into the machinery of their great establishment, in Upper Thames-street, an ingenious American invention for the separation of those portions of flour from the bran which have hitherto been taken away with it, and were therefore lost to the miller. The apparatus is very simple in its details, but works most effectually, and by it a saving is effected of about 6lb. in every quarter of wheat. Two cones, working one within the other, the upper stationary, the lower revolving at a high velocity; and both lined with perforated iron, receive the bran between them. The friction thus set up rubs out the particles of flour; and this process is still further promoted, after the bran has passed through the cones, by its being blown through a fencing of four-cornered nail-iron, placed vertically round the summit of a drum which rotates on its axis. This drum has projecting ribs attached to it, which act as beaters; and by them the flour is driven through a fine wire screen or sieve, the operation being facilitated by the tap of a hammer at regular intervals on the top of the sieve. In this way the separation of the flour from the bran is effectually accomplished, the former passing through the sieve, and the latter being retained behind it. The simplicity of the arrangement makes one wonder that it has not been introduced long ago. Here is another example of the important economies which can be gained by the judicious treatment of waste materials. In the City

* Upon the site of Puddle Dock is constructed the *City Flour Mill*, by far the largest flour mill in the world, and a gigantic example of mechanical skill. It is built entirely upon piles, and occupies rather more than an acre, or 260 feet long by 60 feet wide. The mill consists of eight stories; two steam-engines, of the consecutive power of 300 horses, drive 60 pairs of enormous mill-stones, and work the Archimedean screws and buckets by which the flour is conducted through the different processes. This mill has stowage for 40,000 quarters of grain; can prepare 40,000 quarters per week; and requires only one-sixth of the number of hands employed by the old system.—See *Curiosities of London*, p. 710.

Flour Mill the loss of fine flour which flies off in dust, and which in other establishments is calculated at from 8½lb. to 9lb. per quarter, is, by a clever screening contrivance, which was described in the *Times* when the mill was first started, reduced to from 5½lb. to 6lb., so that these two improvements represent a saving of 9lb. of flour in every quarter of wheat. In so large an establishment, working 30 pairs of stones, and representing the performance of 60 pairs driven on the old plan, without the blast of cold air between the stones, results of this kind are of the greatest importance; and even to the general public they are not uninteresting at a moment when the scarcity and high price of the staff of life are attracting such serious attention.—*Times.*

VALUE OF A KNOWLEDGE OF MECHANICS IN AUSTRALIA.

In an Inaugural Address delivered at the Mechanics' School of Arts in Sydney, by Sir Thomas Mitchell, D.C.L., the President of the Institution, we find some noticeable details of the progress of that colony, and of the difficulties overcome in acquiring a geographical knowledge of Australia. "In first scaling the heights of Australia Felix," Sir Thomas remarked, "a house carpenter was to me, in a small way, what Tullius Labienus was to Julius Cæsar in his passage into Gaul. Wheelwrights and blacksmiths were my best soldiers on the banks of the Murray. By such aids my little party were enabled to effect the passage of that great river during one of its mightiest floods, and at a season when the earth was so soft that our wheel-tracks, although made twenty years ago, are still visible in many parts where our progress with heavy carts through mud was not more sometimes than one mile in a day. Few are aware that but for very nice mechanical appliances, the expeditionary party that reached the shores of the Southern Ocean would never have returned. Two boats carried on a waggon, and slung in canvas so as to float within a frame, were taken from Sydney across the Blue Mountains, down the Lachlan, to the river Murray, so as to enable me to force a passage, as I have said, during a heavy flood, in the face of hostile natives. Again, we packed up our boats, and carried them to the Glenelg, navigating and surveying which at one time we reached that shore which now encircles so much wealth. Through mud, the same boats were brought back; and through 'Expedition Pass,' where, as if to efface all remembrance of such toils, the very name of 'Mount Byng' has been changed to Mount Alexander." In building bridges for the infant colony there were great difficulties until Sir Thomas accidentally lighted upon "a mechanic, who was then employed on day wages, cutting the coping-stone of the dwarf wall in front of the Council Chambers in Macquarie-street. I allude," the lecturer stated, "to Mr. David Lennox, who left his stone wall at my request, and with his sleeves still tucked up, came with me to my office, and undertook to plan the stone bridges we required, make the centreing for arches, and to carry on such works, by directing and instructing the common labourers then at the disposal of Government. Thus originated all the bridges this colony possesses at all worthy of the name." Another mechanical genius is thus commemorated:—"When our late King's Astronomer at Parramatta, Mr. James Dunlop,

F.R.S., was assisting the fitting-out of an exploratory expedition, destined for the interior, in 1835, he could not find in the blacksmith's shop at Parramatta a pair of pincers that would grip the cistern of a mountain barometer he wanted to unscrew and repair. To the amazement of surrounding smiths, he thrust the useless pincers into the fire, set the bellows a-blowing, with the hand of a master in the craft, and very soon produced upon the anvil the form he required for his purpose. Mr. Dunlop was a remarkable instance of original genius. Originally a mechanic, his mind rose to the noblest objects of human pursuit, and, whilst at the Observatory of Parramatta, he was the referee on all subjects connected with astronomical phenomena; much assistance did he afford on other subjects—even in mechanics. The boat-carriage alluded to before was modelled by Mr. Dunlop."—*Athenæum*, No. 1458.

SUSPENSION STRUCTURES.

In a discussion by the Institution of Civil Engineers, upon Mr. Barton's paper "On the Economic Distribution of Material in the Sides, or Vertical Portion of Wrought-iron Beams," by way of illustration, reference was made to the Railway Suspension-Bridge, of 822 feet span, across the Niagara river, at a height of 250 feet above the water. This bridge is said by some to settle the question as to the possibility of running heavy trains on an ordinarily suspended roadway. It hangs by four cables, each containing 3640 wires, and estimated to be altogether a weight of 7000 tons; and has two platforms, the lower one being for horses and vehicles. The first train that passed over weighed 366 tons; it produced a deflection of one foot, but very little undulation. The engineer, Mr. Roebling, has built a Suspension-Aqueduct over the Ohio at Pittsburgh; and is building a Suspension-Bridge, 1224 feet long, for the Lexington and Danville Railway, across the Kentucky river, at a height of 300 feet above the stream. In face of these achievements by our American cousins, it is argued that our Britannia Bridge was a mistake—that more than half the weight and cost of iron might have been saved—that the science of beam-making is better understood now than it was a few years ago. But on the other side, good reason is shown in support of what has been done by English engineers, and for waiting to see the effect of time and traffic on suspension-railway bridges. Mr. W. H. Barlow, of Derby, has helped the question somewhat by a paper on an Element of Strength in Beams, in which he shows that their fibrous arrangement has not been sufficiently taken into account.—*Chambers's Journal.*

Natural Philosophy.

THE STANDARD OF MEASURE.

An important Inquiry has been conducted before a Select Committee of the House of Lords, upon the provisions of a Bill before their Lordships, "for Legalizing and Preserving the restored Standard of Weights and Measures;" upon which we find the following judicious remarks, embodying the object of the measure, in the *Times* journal :—

"The Inquiry relates specifically to the Standard of Measure; but before explaining the exact question at issue, it may be as well to recall the circumstances under which it has arisen. It will be remembered that the old Standards were lost in the fire which destroyed the former Houses of Parliament; and that in consequence, so far back as the 11th May, 1838, a Royal Commission was appointed to consider the steps to be taken for their restoration. This Commission consisted of a number of scientific men, including, among others, the Astronomer Royal. By them it was decided to adopt as a standard of measure a standard yard, the dimensions of which are determined by measuring with the aid of microscopes the distance between two points, indicated by lines traced on a bar of gun-metal. Accordingly, the Bill before the House of Lords contains a minute description of this standard yard, which, in compliance with the recommendation of the Royal Commission, the Government proposed to legalize. It turned out, however, that while our philosophers and men of science were engaged in determining in their own way the most perfect means for securing accuracy of measurement, Mr. Whitworth, of Manchester, had, for practical objects of great importance to the nation at large, as well as to himself individually, been directing his attention to the same subject. He wanted a measuring machine as perfect as he could make it, in order to secure increased accuracy in his system of gauges, and generally in the workmanship of those tools for the manufacture of which he enjoys so deserved a celebrity. In order that the importance of such a measuring machine may be fully appreciated, it may be well to refer to the illustration afforded by the Baltic fleet. The Admiralty, in the construction of their marine engines, have always wisely insisted upon the use of Whitworth's Registered Gauges; so that if a screw or plug, or fastening of any kind gives way, a substitute of the same register, and therefore certain to fit, can at once be produced. Hence it follows that one not very large floating mechanic's shop is quite sufficient to meet all the emergencies of the service in the way of damaged machinery for the whole of that mighty steam armada now facing the batteries of Cronstadt. Such a result would be utterly unattainable but for that extraordinary nicety in determining sizes to which Mr. Whitworth has attained. It may be recollected that at the Exhibition of 1851, Mr. Whitworth showed a machine which measured to the millionth part of an inch, and which enabled any one to calculate the expansion caused

in a bar of iron a yard long by touching it lightly for a moment with the finger tip. The same arrangement is now adopted by him for the production of standards of measure; the principle being that the standard is obtained by measuring the distance between the perfectly flat ends of a solid bar having true surfaces on its sides and ends. His test is that of the touch; by it he can correct errors in dimensions up to the millionth of an inch, whereas the plan of the Royal Commissioners, depending on the sight, aided by the microscope, can only correct errors to the 60,000th of an inch. The most powerful microscope that has yet been made cannot enable the eye to distinguish more than 60,000 lineal divisions in an inch; and in order to reach this degree of accuracy, the object-glass must be so near as greatly to interfere with the practical utility of the standard. But with end measurement, an accuracy carried to a point twenty times as great can be combined with a perfect facility of application to all the purposes for which such a standard is desirable.

"Again, after devoting so much time and expending so much labour on constructing their standard of line measure, the Commissioners have not succeeded in producing two alike when measured at a like temperature; and this will be understood when it is remembered that a line once traced on the bar cannot be altered, and that the only means of correcting it if wrong is to change the temperature, so that the metal may expand or contract, until an approximation to accuracy is attained. Hence, in the Bill, a separate temperature is provided for each copy. On the other hand, the standards of end measures can be copied to any requisite extent, and any difference not smaller than the millionth of an inch will be readily detected. By taking care to make the copy slightly too long, its errors in excess may be gradually removed by repeated corrections, each of which may be measured until a complete *fac simile* is obtained. But further, in mechanics especially, where extreme delicacy of fitting and the production of accurate duplicates are of the greatest importance, standards for the foot and inch are even more necessary than those for the yard. For the supply of these the plan of the Royal Commission made no provision; whereas Mr. Whitworth is able to produce them in the same perfection as the yard standard. Finally, it affords a simple method of contrasting the merits of the two systems to state that in line measurement the eye has only to pass over the distance actually measured, and when that is very small the limited power of the sight, aided even by the microscope, in distinguishing difference, operates as a great check; whereas in the apparatus employed in end measuring, the eye has to travel over a distance of about 40 inches to trace the variation of a thousandth of an inch. From all these considerations it is obvious—and the result is a highly instructive one—that a private manufacturer, pursuing steadily that course of experiment on which he well knows the success of his business to depend, has been enabled completely to distance the efforts of a body of highly scientific men, constituted expressly for the purpose, and working at it with no small expenditure of the public money during a period of sixteen years. Yet so oddly are such matters managed in this country, that the Bill for legalizing the standards of weights and

measures had passed the House of Commons, and was half-way through the House of Lords, before Mr. Whitworth's invention, publicly exhibited in 1851, recognised by the Admiralty and the Board of Ordnance, and generally accepted by all the leading machinists of the kingdom, was brought before the notice of the Legislature. Thanks, however, to the Select Committee of the House of Lords, and to the personal interest shown in the subject by Lord Hardinge, Earl Granville, and other peers, the blunder which was well-nigh being committed will now, we trust, for all practical purposes, be avoided. Mr. Whitworth, when examined before the committee, produced and explained his Measuring Machine; and so satisfactory was his evidence, that the Committee came to the decision of recommending that his standard yard measure, constructed of the same length as that of the Royal Commission, be legalized as the 'secondary standard,' for comparison with local standards of measure throughout the country, and that his standard foot and inch have the same sanction attached to them.

"To those who have paid any attention to the state of industry in England, it is unnecessary to point out the immense advantage which we possess in the extraordinary finish which, in mechanics especially, we impart to our workmanship. This arises from the attention which has been paid to two objects—one the formation of a true plane, the other the power of measurement, carried to a point as near as possible to perfection. There was a time when in the machine shops throughout the country 'the big inch,' 'the middling inch,' and 'the little inch' were all recognised, and even still there are important branches of manufacture—such as, for example, the gun trade, in which the gauges used hardly deserve the name. To legalize, therefore, the best standards of measure that can be obtained, is an object of national importance; and we rejoice that even at the eleventh hour steps have been taken to avoid in this respect a serious legislative blunder."

SCIENCE AND THE GOVERNMENT.

WE quote from the *Athenæum*, No. 1446, the following stringent remarks upon the unbecoming conduct of the British Government, with regard to their Grant to the Royal Society:—

"We had occasion last week (July 7), to comment on the miserable allowance doled out to men of science and literature by the Government of this wealthy country, with reference to the distribution of pensions out of 1200*l.* annually granted by Parliament for the reward of distinguished services. Another, and if possible a more flagrant case of the disregard by Government of the claims of science has recently come to our knowledge. In 1849, the Earl of Rosse, then President of the Royal Society, received a letter from Lord John Russell informing him that it was the intention of Her Majesty's Government to place 1000*l.* at the disposal of the President and Council of the Royal Society, for the promotion of science. Of course, no specific pledge could be given that this sum would be granted annually, yet there was every reason to hope, and indeed believe, that the grant would be continued. Accordingly, the Council of the Royal Society unanimously agreed to accept the

liberal offer of Government, and a large Committee, consisting of all the members of Council, and the most eminent scientific men, was appointed to consider and report upon the best mode of applying the grant. After several meetings, it was recommended:—First, and chiefly, that the grant be awarded in aid of private individual scientific investigation. Secondly, in aid of the calculation and scientific reduction of masses of accumulated observations. Thirdly, in aid of astronomical, meteorological, and other observations, which may be assisted by the purchase and employment of new instruments. Fourthly, and subordinately to the purposes above named, in aid of such other scientific objects as may from time to time appear to be of sufficient interest, although not coming under any of the foregoing heads. In accordance with these judicious recommendations, the Grants for the years 1850, 51, 52, 53, and 54 have been distributed to the great benefit of science. Among the eminent persons whose scientific investigations have been promoted by grants from this fund may be mentioned, Professor Owen, Colonel Sabine, Professor Stokes, the Astronomer Royal, Dr. Carpenter, Professor Hopkins, Mr. Horner, Professor Miller, Dr. Tyndall (who at his Lectures before the Royal Society and the Royal Institution, acknowledged how greatly he was indebted to this grant for enabling him to purchase foreign instruments essential for his investigations), Mr. Huxley, and Mr. De la Rue. These names alone are sufficient guarantees that the money has been applied to the best objects; and we have reason to know that in many instances experiments have been made which have produced results productive of such national advantages as will in a commercial point of view alone repay the sum expended over and over again. We particularly allude to the important experiments by Messrs. Fairbairn, Hodgkinson, and Hopkins, on the strength of materials used in engineering works, which have been and are carried on by those gentlemen without further cost than the mere expense of the machinery and raw materials. It will scarcely be credited, that Government, while calling into requisition the gratuitous services of the Fellows of the Royal Society for the benefit of the nation, has refused to continue this year the grant of 1000*l.* Apart from the blow to science which this refusal strikes, is it wise policy to declare in the face of nations that England, with her vast resources, is yet so stricken by the war that she can no longer devote 1000*l.* a-year to the promotion of science? This, indeed, will be news for the Czar, who, with a deficient exchequer, continues to endow his famous Metropolitan Academy of Sciences. We hold that the withdrawal of this grant is as unjust as it is impolitic. Government has never been backward in requesting scientific aid from the Royal Society. A few months only have elapsed since it called upon the Society to give their opinion as to what are the great meteorological desiderata with reference to a Government department for meteorology, which it was proposed to establish for the advantage of navigation. This request was immediately responded to. Circulars were addressed to eminent meteorologists and men of science at home and abroad; and, after long and laborious deliberations, a voluminous report was drawn up and transmitted to Government. All this time and labour was, be it remembered, *given gratuitously*, by

men who are not the best able to make a present of their time and valuable knowledge. It is scarcely creditable to the State that such services should be rewarded by the withdrawal of the annual grant."

The grant to the Royal Society was, however, renewed; but not until the meanness and ignorance of the Government had been exposed and unsparingly condemned by nearly every public journal in the empire. It is this scandalous neglect of Science and its appliances (of which every other European Government vigilantly profits) that has reduced our national resources in the conduct of the war to an almost degraded position.—Ed. *Year-Book of Facts.*

PLATO'S SURVEY OF THE SCIENCES.

The Master of Trinity College, the Rev. Dr. Whewell, has read to the Cambridge Philosophical Society a paper on "Plato's Survey of the Sciences," contained in the Seventh Book of the Republic. Plato, like Francis Bacon, took a review of the sciences of his time; and, like him, complained how little attention was given to the philosophy which they involved. The sciences which Plato enumerates are arithmetic and plane geometry, treated as collections of abstract and permanent truths; solid geometry, which he notes as deficient in his time, although, in fact, he and his school were in possession of the doctrine of the five regular solids; astronomy, in which he demands a science which should be elevated above the mere knowledge of phenomena. The visible appearance of the heavens only suggests problems with which astronomy deals, as beautiful geometrical diagrams do not prove, but only suggest, geometrical propositions. Finally, Plato notices the subject of harmonics, in which he required a science which shall deal with truths more exact than the ear can establish; as in astronomy, he requires truths more exact than the eye can assure us of. It was remarked also, that such requirements had led to the progress of science in general, and such inquiries and discoveries as those of Kepler in particular.

POLARITY OF DIAMAGNETIC BODIES.

Professor Tyndall has communicated to the British Association an "Experimental Demonstration of the Polarity of Diamagnetic Bodies." The author referred to the Bakerian Lecture of the past year, 1855, as proving that a bar of bismuth freely suspended within a spiral of copper wire, excited by a current passing through that wire and acted upon by external magnets, could be attracted and repelled with the same certainty as, though with a far less energy than, a bar of iron,—the sense of the deflection, which indicated the polarity of the diamagnetic bismuth bar, being always opposed to the deflection of the iron bar under the same circumstances. The experiments now described formed the complement, so to speak, of those described in the lecture referred to. In the latter case the bismuth bar was deflected by magnets, but as the action is mutual, it is to be expected that the magnets, if properly arranged, could be deflected by the diamagnetic bars. An experiment of this nature has already been made by Professor Weber, of Göttingen, but the results obtained by this dis-

tinguished experimenter have not commanded general conviction; they have been denied and criticised by Matteucci and others.

Professor Tyndall has to thank M. Weber for the plan of an instrument, constructed by M. Leyser, of Leipsic, which has enabled him to remove the last trace of doubt from this important question. The instrument consists essentially of two upright spirals of copper wire about eighteen inches long, fastened to a stout slab of wood, enclosed on all sides during the time of experiment, and so fixed into solid masonry that the spirals were vertical. Above the spirals is a wooden wheel with a grooved circumference; below the spirals there is a similar wheel; an endless string passes tightly round both wheels, and to this string were attached two cylinders of the diamagnetic body to be examined. By turning the lower wheel by a suitable key, the cylinders may be moved up and down within the spirals. Two steel bar magnets are arranged to an astatic system, connected together by a rigid brass junction, and suspended so that both magnets are in the same horizontal plane. It is so arranged that these two magnets have the two spirals between them, and have their poles opposite to the centre of the spirals. When, therefore, a current is sent through the spirals, it exerts no more action on the magnets than the centre or neutral point of a magnet would do. Supposing the bars within the spirals to be also perfectly central, they also present their neutral points to the magnetic pole, and hence exert no action upon it. But if the key be turned so as to bring the two *ends* of the diamagnetic bars to act upon the suspended magnets, if the bars be polar, the magnitude and nature of their polarity will be indicated by the consequent deflection of the magnets. The index by which the deflection of the magnets is observed is a ray of light reflected from a mirror attached to the magnets; and, as the length of this ray may be varied at pleasure, the sensibility of the instrument may be indefinitely increased. When cylinders of bismuth are submitted to experiment, a very marked deflection is produced, indicating a polarity on the part of the bismuth opposed to the polarity of iron.

This is the result already obtained by M. Weber; but against it, it has been urged that the deflection is due to induced currents excited in the metallic cylinders during their motion within the spirals. To this objection Professor Tyndall replied as follows:—first, the deflection produced was a *permanent* deflection, which could not be the case if it were due to the momentary currents of induction;—secondly, if due to induction, copper ought to show the effect far more energetically than bismuth, for its conducting power; consequently, the facility with which such currents are produced is, at least, fifty times greater than that of bismuth. But with cylinders of copper no sensible deflection was produced;—thirdly, two prisms of the heavy glass with which Mr. Faraday discovered the diamagnetic force, and produced the rotation of the plane of polarization of a luminous ray, were substituted for the metallic cylinders; and, although the action was far less energetic, it was equally certain as in the case of bismuth, and indicated the same polarity. The formation of induced currents is wholly out of the

question here, for the substance is an insulator. The experiments, therefore, remove the last remaining doubt from the position that diamagnetic bodies under magnetic excitement possess a polarity which is the reverse of that possessed by magnetic ones. Professor Tyndall, in referring to his labours on this subject, and to the beautiful and costly apparatus by which these results have been obtained, observed that it was the funds placed at his disposal by the Council of the Royal Society, which enabled him to obtain these results; and this may be taken as an example of the manner in which the annual Government grant is applied to the promotion of scientific research and discovery.—*Athenæum*, No. 1457.

ON THE HEAT PRODUCED BY THE INFLUENCE OF THE MAGNET UPON BODIES IN MOTION. BY M. LEON FOUCAULT.

In 1824, Arago observed the remarkable fact of the attraction of the magnetic needle by conducting bodies in motion. This phenomenon appeared very singular, and remained without explanation until Faraday announced the important discovery of currents of induction. It was then proved, that in Arago's experiments the motion gave rise to currents, which, by reacting upon the magnet, tended to associate it with the moveable body, and draw it in the same direction. It may be said, in general terms, that the magnet and the conducting body tend towards a state of relative repose by a mutual influence.

If, notwithstanding this influence, the motion continue, a certain amount of force must be constantly furnished, the moveable part be, as it were, pressed by a break; and this force necessarily produces a dynamic effect, which, according to the new doctrines, I have thought must be found in heat.

We arrive at the same consequence by taking into consideration the currents of induction which succeed one another in the interior of the body in motion; but an idea of the quantity of heat produced could only be acquired with great difficulty by this mode of regarding the affair; whilst, by considering this heat as due to a transformation of force, it appeared certain to me that a sensible elevation of temperature would be easily produced in a decisive experiment. Having ready to my hand all the elements necessary for a prompt verification, I proceeded to its execution in the following manner.

Between the poles of a strong electro-magnet I partially introduced the solid of revolution belonging to the apparatus which I have called a *Gyroscope*,* and which was previously employed in experiments of a very different nature. This solid is a ring of bronze connected by a toothed pinion with an apparatus of wheels, by the action of which, when turned by the hand, it may revolve with a rapidity of 150 or 200 turns in a second. To render the action of the magnet more effective, two pieces of soft iron added to the helices prolonged the magnetic poles, and concentrated them in the vicinity of the revolving body.

When the apparatus is going with the greatest rapidity the current of six Bunsen's couples, passed into the electro-magnet, stops the movement in a few seconds, as though an invisible break had been

* Described in the *Year-Book of Facts*, 1855, page 145.

applied to the moving body; this is Arago's experiment, as developed by Faraday. But if the handle be then pushed on, so as to restore to the apparatus the movement which it has lost, the resistance experienced requires the application of a certain amount of force, the equivalent of which reappears and accumulates in heat in the interior of the revolving body.

By means of a thermometer inserted in the mass we may follow the gradual elevation of temperature. Having, for example, taken the apparatus at the surrounding temperature of 60°·8 F., I saw the thermometer rise successively to 68°, 77°, 86°, and 93°·2 F.; but the phenomenon had previously become sufficiently developed to render the employment of the thermometer unnecessary, as the heat produced had become sensible by the hand.

If the experiment appears worthy of interest, it would be easy to arrange an apparatus to reproduce and exaggerate this phenomenon. There is no doubt that by means of a machine properly constructed, and composed only of permanent magnets, high temperatures might be produced, so as to place before the eyes of the public assembled in lecture rooms a curious example of the conversion of force into heat.—*Comptes Rendus*, Sept.; *Philosophical Magazine*, No. 68.

ATTRACTION OF MOUNTAINS.

THE Astronomer Royal has communicated to the Royal Society a paper on the "Computation of the Effect of the Attraction of Mountain-masses, as disturbing the apparent astronomical latitude of stations in Geodetic Surveys."

The author commences with remarking that his surprise had been excited by the result obtained by Archdeacon Pratt, namely, that the computed attraction of the elevated country north-east of India considerably exceeds the disturbance which it was sought to explain. But on consideration, the author perceived that this result might have been anticipated, on the extensively received supposition that the interior of the earth is a dense fluid or semi-fluid (which, for convenience, he calls *lava*), and that the exterior crust floats upon it. For, he remarks, this crust cannot be supposed at any part to be very high upwards (as in mountains), at least to any great horizontal extent, unless there is a corresponding projection downwards into the lava. Upon making a numerical calculation, even with the crust one hundred miles thick, it was shewn that there would be such a tendency of the table-land to crack and sink in the middle as no cohesion of rocks can resist. He conceives that the state of the ground may be properly illustrated by a raft of timber floating on water: if one piece of timber projects higher into air than the others, we are certain that it also projects lower into water than the others. Assuming this as established, then it is evident that the horizontal attraction of a mountain mass on a point at a considerable distance is nearly evanescent, because the increase of attraction of the part which is above the general level is sensibly neutralized by the deficiency of attraction below it where the lighter crust displaces the heavier lava. In like manner, the horizontal attraction of a ship or other floating body is nothing. But the horizontal attraction upon a

near point on the earth's surface will not vanish, because the mountain which produces the positive attraction is nearer than the lava-displacement which produces the negative attraction: even here, however, the efficient disturbing attraction will be much less than that computed by considering the dimensions of the mountain only.

CORRECTION OF COMPASS ERRORS.

THE difficulty hitherto experienced with the compass in iron ships has been successfully removed by a discovery of Mr. J. M. Hyde, of the Cumberland Iron Works, Bristol, who has been for the last ten years engaged in the investigation of this important subject. There is trading between Liverpool and Bristol a screw-steamer called the *Athlete*, built by Messrs. J. M. Hyde and Co., having no practical error in the compass, and therefore requiring no permanent magnets for correction. This desideratum has been accomplished in the construction of the ship, the arrangement being such that the compass is placed in a neutral position, where the magnetism of the iron in the after end of the ship is balanced. If this information be correct, then Mr. Hyde has accomplished an improvement, the importance of which it would be difficult to over-rate. The numerous and lamentable errors said to have occurred through compass errors is a sufficient reason why this discovery should be thoroughly investigated for the benefit of that large and increasing interest, iron shipping.

DECIMAL COMPASS CARD.

THE Mariners' Compass-needle having of late years received great improvements, Mr. James M. Share, Master R.N., is of opinion that it is high time the Card, as at present arranged, should take its place by the side of such things as are superseded by others better adapted to the advancing spirit of the times. He therefore ventures to make an attempt to innovate on an old custom, by suggesting the substitution of a compass-card containing thirty-six points of ten degrees each—every degree being one-tenth of a point.

By the use of this card the mariner will avoid the constantly recurring trouble of turning degrees into points, and *vice versâ*.

The ship's course having been worked out in degrees, the deviation and local attraction have but to be applied to adapt it to the decimal steering card, thus rendering the "traverse table for points" no longer necessary to those steering by it; the course N. 35° E. being the same as "north three and a-half points east," &c. The same remark applies also to astronomical bearings, azimuths, amplitudes, &c.

Should the decimal card be adopted, the old-fashioned method of "boxing the compass," which takes young people so long to become familiar with, will be entirely superseded; and the sooner such method becomes obsolete, the better it will be for the interests of the mariner; for, together with other advantages, the tedious operation of a "day's work" will be divested of half the usual trouble.

When giving a course to the "quarter-master," or "man at the wheel," no mistake, so liable to be the case at present, can well occur; it will merely be necessary to direct him to steer, for instance, "north

five points east," or more briefly, "north five east," "south six west," &c., &c.

Mr. Share recollects an instance of a vessel steering N.W. by N. ½ N., instead of W. by N. ½ N. during thick weather in the Bristol Channel, thus running into danger from the similarity of sound between the courses alluded to.

The practical application of the decimal card would not materially affect the charts previously published, which could have printed compasses containing thirty-six points pasted over the others. Such might be supplied by any chart-seller.—*Proceedings of the Royal Society.*

ON THE LUMINOUS COAT OF THE INDUCTION SPARKS OF RUHMKORFF'S APPARATUS. BY T. DU MONCEL.

WHEN examining these sparks in the dark, the author observed that they are surrounded with a greenish-yellow luminous coat, the thickness and form of which varies according to the strength of the current, and the nature of the wires forming the poles; when the sparks are not very long, however, the luminous coat is almost always of an oval form. It appears to belong principally to the negative pole, and is of a reddish colour on the side of this pole. It is remarkably intense, and resembles a flame when the poles are moistened with an essential oil, and its connexion with the negative pole is also then very distinct.

If the wires of the pole (which should be rather thick) be placed about five millimetres apart, and the intervening space be blown upon rather strongly with a bellows, the greenish-yellow atmosphere is seen to be drawn towards the opposite side, where it forms a large flame of a violet colour. It may also be blown along the wires of the pole, and it is then seen to be furrowed by a number of very sinuous, more or less white jets of fire, which are usually disposed in strata. The violet light appears to be circumscribed by two bundles of violet rays, which rise from the points of the poles and unite in irregular curves, like those of a flame driven by the wind. The true spark does not appear to be affected by the current of air.—*Comptes Rendus*, Feb. 5, 1855; *Philosophical Magazine*, No. 62.

RATE AT WHICH WAVES TRAVEL.

A PAPER has been read by Professor Bache, before the American Scientific Association, stating, that at nine o'clock on the morning of the 23rd of December, 1854, an earthquake occurred at Simoda, on the island of Niphon, Japan, and occasioned the wreck of the Russian frigate *Diana*, which was then in port. The harbour was first emptied of water, and then came in an enormous wave, which again receded and left the harbour dry. This occurred several times. The United States has self-acting tide-gauges at San Francisco and at San Diego, which record the rise of the tide upon cylinders turned by clocks; and at San Francisco, 4800 miles from the scene of the earthquake, the first wave arrived twelve hours and sixteen minutes after it had receded from the harbour of Simoda. It had travelled across the broad bosom of the Pacific Ocean at the rate of six miles and a-half a minute, and arrived safely on the shores of California, to astonish the scientific

observers of the Coast-Surveying Expedition. The first wave, or rising of the waters, at San Francisco, was seven-tenths of a foot in height, and lasted for about half an hour. It was followed by a series of seven other waves of less magnitude, at intervals of an hour each. At San Diego similar phenomena were observed, although, on account of the greater distance from Simoda (400 miles greater than to San Francisco), the waves did not arrive so soon, and were not quite as high.—*Boston Atlas.*

HYDROLOGY OF THE BRITISH ISLES.

In collecting materials for the Hydrology of the British Isles, in connexion with Mr. Keith Johnston, for the second edition of his *Physical Atlas*, the author has obtained, from published and unpublished sources, upwards of one hundred records of Rain Stations and Temperature. These amounts were marked down in their respective positions on the map of Britain, and this map was coloured with light and dark shades according as the amount of rain-fall was small or large in the locality. The map exhibited showed, in the first place, what had been already done, and what parts of the country yet remained to be filled up by observation and registration. A considerable portion of the surface of Britain and Ireland was observed to be dotted with figures, but a large part of Wales and the north-west coast of Scotland were deficient. If we take three waving lines along the map of Great Britain, we shall meet with three gradations of rain-fall. The line along the east coast, and penetrating some way into the interior, marks out the region of least deposition. On the whole eastern side of England, from Kent and Surrey, and Oxford, north to York, the average annual fall of rain is 23 to 24 inches. From Durham, north into Scotland, the mean fall is 27 inches; though in some localities, as Mid-Lothian and Morayshire, the rain-fall is from 24 to 25 inches. The mean annual rain fall of the whole eastern half of Great Britain is 27 inches. If we take a middle line, which includes the mountain range that traverses England from south to north, and extends through the centre and west of Scotland, we find that here is the greatest amount of deposition. In the mountains of Cumberland and Westmoreland, from 50 to 140 inches of rain fall annually. South of this range throughout England, from 36 to 46 inches are deposited. In Scotland, from the Lowther Hills to the mouth of the Clyde, from 47 to 50 inches. A third line embraces the west coast near the level of the sea. At Land's End, the annual fall is 42 inches, in Exmoor, 56 inches. As we proceed farther north, the mean fall decreases to 38 and 35 inches. Taking the western half of Britain, including the mountain regions, the annual mean of the rain stations is 45·5 inches; but considering that there is a deficiency of data for the elevated regions of Wales and the north-west of Scotland, and a preponderance of coast stations where the fall of rain is moderate, we may suppose that the actual fall for the western half of Britain is at least 5 or 10 inches more than this average; that is, from 50 to 55 inches. We thus see that the mountain regions of Britain, by their superior elevations, compared with the valleys and plains, and by the consequent diminution of their surface temperature, become the condensers of the moisture of the warm and moist southerly winds.

From the interesting data of Mr. Miller of the Lake district of England, it is also demonstrated that the greatest amount of deposition takes place at an elevation of 1900 feet; and above this, the fall of rain rapidly diminishes.

In Ireland the greatest amount of rain-fall occurs on the south-west coast, 59 inches falling in the vicinity of its highest range of mountains. In the low lying central plain of Ireland the annual fall is 23 and 24 inches; while on the mountain ranges of the north-east and south-east from 30 to 37 inches fall.

If we divide the year into three periods of four months each, beginning the winter period with November, we shall find that most rain falls in the summer and winter months, and least in spring. This is shown in the following tabular view:—

	Spring.	Summer.	Winter.
	Inches.	Inches.	Inches.
Penzance, Cornwall	12·2	13·5	17·4
Keswick	16·0	24·0	19·9
Glasgow	8·3	9·8	15·5
Gilmourton, Lanarkshire	11·6	17·3	18·8
Glencorse, Pentlands	10·2	14·3	11·6
London	6·7	9·2	8·9
Boston	7·2	9·4	6·5
York	7·3	10·0	9·9

On the east coast there are during the year 165 days on which rain falls; on the west coast there are 212 days on which rain falls. The greatest depth of rain noted to have fallen in twenty-four hours, is from 1½ to 2½ inches. At Kendal, in 1792, 4½ inches fell. Our longest continued rains usually begin on the south and west of Great Britain, and proceed northwards. This occurs when an easterly and south-west current both prevail in the atmosphere. In these cases it sometimes takes several days before the dry east wind becomes saturated with moisture, and rain begins to fall on the eastern coasts. Hence the popular idea that our greatest rains come from the east; whereas, in reality, all the deposited moisture comes with the southerly current, and the cold east wind acts merely as the condensing agent.—*Proceedings of the Royal Physical Society.*

MEAN HEIGHT OF THE ATLANTIC AND PACIFIC OCEANS THE SAME.

THE *Panama Star* says:—"On the authority of Colonel Lloyd and Captain Falmar, who in 1827, by order of Bolivar, made a series of levels from Panama to Chagres, it has been very generally believed that there existed a difference of mean level between the Atlantic and Pacific Oceans, and many ingenious theories have been devised to account for this (supposed) fact, and elaborate deductions in favour and against the practicability of a ship canal have been drawn therefrom. The difference of the mean heights of the two oceans was stated to be 3·52 feet, the Pacific at Panama being that much higher than the Atlantic at Chagres. It has been lately decided by Colonel Totten, after

a series of careful tidal observations taken here and in Aspinwall (Navy Bay), and connected by accurate levels along the line of railroad, that the mean height of the two Oceans is exactly the same; although, owing to the difference in the rise of tide at both places, there are of course times when one of the oceans is higher or lower than the other; but their mean level, that is to say, their heights at half-tide, is now proved to be exactly the same. There is no doubt that Colonel Lloyd's error arose from imperfection in his instruments, and the difficulty he laboured under in taking a large number of observations, in which mistakes are peculiarly liable to occur."

RELATIVE LEVELS OF THE RED SEA AND MEDITERRANEAN.

The French engineers, at the beginning of the present century, came to the conclusion that the Red Sea was about 30 feet above the Mediterranean; but the observations of Mr. Robert Stephenson, the English engineer, at Suez; of M. Negretti, the Austrian, at Tineh, near the ancient Pelusium; and the levellings of Messrs. Talabat, Bourdaloue, and their assistants, between the two seas; have proved that the low-water mark of ordinary tides at Suez and Tineh is very nearly on the same levels; the difference being, that at Suez it is rather more than one inch lower.—*Leonard Horner, Proceedings of the Royal Society*, 1855.

AN UPRISE IN THE SOUTH SEA ISLANDS.

Mr. Royle, missionary at Aitutaki, in the South Sea Island, describes a dreadful hurricane which took place on that island on the 6th February, 1854. He states "that the physical aspect of the lagoon, inside the distant reef of the island, is completely changed by the hurricane; so much so that he is inclined to suspect that some volcanic violence was at work. Some ten miles of new beach are raised up, composed of coral, rock, sea shell, and rough sand, where before there was nothing but deep water."

UNCERTAINTY OF PRESERVING RECORDS IN WALLS OR FOUNDATIONS OF BUILDINGS.

It is a common practice to place the coins of the time, newspapers, and other documents or records in sealed vessels, under the foundation stones, or in some marked situation in the walls of new public or otherwise important buildings. At a meeting of the American Philosophical Society in April last, Dr. Boyé stated that, "On recently opening the corner-stone of the present High School building of this city (Philadelphia), erected fifteen and a half years ago, in order to deposit its contents in the new building about to be erected, the papers, coins, &c. which had been deposited in a sealed glass jar, were found to be in a perfectly decayed and corroded condition, and saturated with water. Dr. Boyé stated, that, after a careful examination, he is satisfied that the water must have got in from the outside by infiltration, first through the mortar into the cavity, and afterwards from this through the sealing-wax, with which the glass-stopper was secured. The corner-stone consisted of a block of blue marble, in which a rectangular excavation had been made, which was closed at the top by a marble

slab sunk down into the stone and secured by common mortar. The lime used appears to have acted upon and corroded the sealing-wax. The corrosion of the coins is ascribed to the sulphur in the glue or sizing in the paper.—*Proceedings of the American Philosophical Society.*

OBJECT OF SALT IN THE SEA.

At a recent Meeting of the Canadian Institute, a very interesting paper was read by Professor Chapman, of University College, Toronto, on the "Object of the Salt Condition of the Sea." Professor Chapman began by assuming that the sea was created salt from the beginning, and for some beneficent purpose; and then proceeded to discuss the views hitherto advanced in elucidation of this object. The suggestion, that the sea is salt in order to preserve it in a state of purity, was considered to be untenable for several reasons; mainly, however, from the fact, that organic impurities when diffused through a vast body of moving water, whether fresh or salt, become altogether, and very rapidly lost; so much so, indeed, as apparently to have called forth a special agency to arrest the total annihilation of organized matter in its final oscillation between the organic and inorganic worlds. The author alluded to the countless hosts of microscopic creatures which swarm in most waters, and whose principal function has been ably surmised by the great anatomist, Professor Owen, to be that of feeding upon, and thus restoring to the living chain, the almost unorganized matter diffused through their various zones of habitation. These creatures preying upon one another, and being preyed upon by others in their turn, the circulation of organic matter is kept up, and carried through its appointed rounds. If we do not adopt this view, we must at least look upon the Infusoria, the Foraminifera, and many of the higher types, as scavenger agents appointed to prevent an undue accumulation of decaying matter; and thus, as before, the salt condition of the sea does not become a necessity. It was shown also, that, under many circumstances, the amount of saline matter in the sea is not sufficient to arrest decomposition. Other suggestions, to the effect that the sea is salt in order to render it of greater density, and by lowering its freezing-point to preserve it from congelation to within a shorter distance of the poles, were then discussed in their more prominent relations. The value of these suggestions in a secondary point of view was fully admitted, but shown, at the same time, to be scarcely adequate to meet the entire solution of so vast and grand a problem as that which is manifestly involved in the salt condition of the sea. The freezing-point of sea water, for instance, is only 3½° F. lower than that of fresh water; and hence with the present distribution of land and sea—and still less, probably, with that which obtained in former geological epochs—no very important effects would have resulted had the ocean been fresh instead of salt. So far as regards the habitable portions of the world, the present difference would be next to nothing. Professor Chapman here submitted to the Institute a suggestion which he believed to be original, in reference to the question under discussion. He considered the salt condition of the sea as mainly intended to *regulate evaporation*, and to prevent an undue excess of that phenomenon

under the influence of any disturbing causes that might from time to time arise. It is well known that under the same atmospheric pressure different liquids have very different boiling-points; in like manner, saturated solutions evaporate more slowly than weak ones, and these latter more slowly again than pure water. In sea water we have on an average about 3½ per cent. of solid matter, of which about 2·6 consists of chloride of sodium or common salt. The results of certain experiments by the author in reference to evaporation on weighed quantities of ordinary rain-water, and water holding in solution 2·6 per cent. of salt, were then given. The excess of loss of the rain-water over the water of the salt solution was, for the first twenty-four hours, 0·54 per cent.; at the close of forty-eight hours, 1·04 per cent.; after seventy-two hours, 1·46 per cent., and so on, always in an increasing ratio; the experiments in each case being carried on for six days.

Here, then, we have a self-adjusting phenomenon, one of those admirable contrivances in the balance of forces, which an attentive study of nature reveals to us in every direction. If, other conditions being equal, any temporary cause render the amount of saline matter in the sea above its normal value, evaporation goes on the more and more slowly; and, on the other hand, if this value be depreciated by the addition of fresh water in undue excess, the evaporating power is the more and more increased—thus aiding time, in either instance, to restore the balance. In conclusion, the author pointed out that the consideration of this principle might shed some further light on the geographical distribution of fresh and salt water lakes on the present surface of the globe.—*Philosophical Magazine*, No. 58.

REMARKABLE BRAZILIAN DIAMOND.

THE largest and finest Diamond which has yet been found in Brazil has been imported into Revin, and has obtained the name of the "Star of the South." In its rough state it weighs 807·02 grains, or 254½ carats. When cut, it will be reduced to about 127 carats, but will then exceed the Koh-i-noor in size. Independently of its magnitude, it possesses much scientific interest from the regularity of its crystalline forms, and the indications it affords of the mode in which the diamond occurs. The general form of the "Star of the South" is a rhomboidal dodecahedron, having each of its faces bevelled by a face set on very obliquely, so that it has in all 24 faces. On one of its faces there is a pretty deep cavity, obviously produced by an octahedral crystal which has been implanted in it. The interior of this cavity, when examined with a lens, shows octahedral striæ, and it cannot therefore be doubted that the crystal which has left its trace was a diamond. On the posterior face of the crystal there are two other cavities of less depth also showing striæ, and one of them even exhibits traces of three or four different crystals. On the same side of the crystal there is a flat part where the cleavage appears, and which M. Dufrenoy considers to be a fracture, and possibly as the point by which the diamond was attached to its matrix. From these facts it appears that the "Star of the South" has been only one of a group of diamonds, similar to the groups of rock crystal, calc spar, or any other crystalline mineral.—*Comptes Rendus*, vol. xl., p. 3.

EXISTENCE OF ACARI IN MICA.

SIR DAVID BREWSTER lately, while examining with a microscope a thick plate of mica from Siberia, about 5 inches long and 3 inches wide, was surprised to observe the remains of minute animals, some the 70th of an inch, and others only the 150th of an inch in size. Some of these were inclosed in cavities, round which the films of Mica were in optical contact. The Acari were, of course, not fossil, but must have insinuated themselves through openings between the plates of mica, which afterwards closed over them.—*Proceedings of the British Association.*

PERIOD OF HUMAN LIFE.

M. FLOURENS, the distinguished French physiologist, and Perpetual Secretary of the Paris Academy of Sciences, has published a work, in which he announces that the normal period of the life of man is *one hundred years.* The grounds on which he comes to this new philosophic conclusion may be briefly stated. It is, we believe, a fact in natural history that the length of each animal's life is in exact proportion to the period it is in growing. Buffon was aware of this truth, and his observations led him to conclude that the life in different species of animals is six or seven times as long as the period of growth. M. Flourens, from his own observations and those of his predecessors, is of opinion that it may be more safely taken at five times. When Buffon wrote, the precise period at which animals leave off growing, or to speak more correctly, the precise circumstance which indicates that the growth has ceased, was not known. M. Flourens has ascertained that period, and thereon lies his present theory: "It consists," says he, "in the union of the bones to their epiphyses. As long as the bones are not united to their epiphyses the animal grows; as soon as the bones are united to their epiphyses the animal ceases to grow." Now, in man, the union of the bones and the epiphyses takes place, according to M. Flourens, at the age of twenty: consequently, he proclaims that the natural duration of life is five times twenty years. "It is now fifteen years ago," he says, "since I commenced researches into the physiological law of the duration of life, both in man and in some of our domestic animals, and I have arrived at the result that the normal duration of man's life is one century. Yes, a century's life is what Providence meant to give us." Applied to domestic animals, M. Flourens's theory has, he tells us, been proved correct. "The union of the bones with the epiphyses," he says, "takes place in the camel at eight years of age, and he lives forty years; in the horse at five years, and he lives twenty-five years; in the ox at four years, and he lives from fifteen to twenty years; in the dog at two years, and he lives from ten to twelve years; and in the lion at four years, and he lives twenty." As a necessary consequence of the prolongation of life to which M. Flourens assures man he is entitled, he modifies very considerably his different ages. "I prolong the duration of infancy," he says, "up to ten years, because it is from nine to ten that the second dentition is terminated. I prolong adolescence up to twenty years, because it is at that age that the development of the bones ceases, and

consequently the increase of the body in length. I prolong youth up to the age of forty, because it is only at that age that the increase of the body in bulk terminates. After forty the body does not grow, properly speaking; the augmentation of its volume, which then takes place, is not a veritable organic development, but a simple accumulation of fat. After the growth, or more exactly speaking, the development in length and bulk has terminated, man enters into what I call the period of invigoration, that is—when all our parts become more complete and firmer, our functions more assured, and the whole organism more perfect. This period lasts to sixty-five or seventy years; and then begins old age, which lasts for thirty years."

But though M. Flourens thus lengthens man's days, he warns him, more than once, that the prolongation of them can only be obtained on one rigorous condition, "that of good conduct, of existence always occupied, of labour, of study, of moderation, of sobriety in all things." To those who may be disposed to ask, why it is, that of men destined to live a hundred years so few do so, M. Flourens answers triumphantly —"With our manners, our passions, our torments man does not die, he kills himself!" and he speaks at great length of Cornaro, of Lessius, and mentions Parr and others, to show that, by prudence, and, above all, *sobriety*, life can easily be extended to a century or more. Such is an outline of M. Flourens' singular argument, and, knowing the author's scientific eminence, we doubt not it will be received with respect.—*Literary Gazette*, No. 1985.

MOTIONS OF ALCOHOLIC LIQUORS.

MR. J. THOMSON has communicated to the British Association a paper "On certain Curious Motions observable on the Surfaces of Wine and other Alcoholic Liquors." The phenomena of capillary attraction in liquids are accounted for according to the generally received theory of Dr. Young, by the existence of forces equivalent to a tension of the surface of the liquid, uniform in all directions, and independent of the form of the surface. The tensile force is not the same in different liquids. Thus it is found to be much less in alcohol than in water. This fact affords an explanation of several very curious motions observable, under various circumstances, at the surface of alcoholic liquors. One part of these phenomena is that if, in the middle of the surface of a glass of water, a small quantity of alcohol, or strong spirituous liquor, be gently introduced, a rapid rushing of the surface is found to occur outwards from the place where the spirit is introduced. It is made more apparent if fine powder be dusted on the surface of the water. Another part of the phenomena is, that if the sides of the vessel be wet with water above the general level surface of the water, and if the spirit be introduced in sufficient quantity in the middle of the vessel, or, if it be introduced near the side, the fluid is even seen to ascend the inside of the glass until it accumulates in some places to such an extent that its weight preponderates, and it falls down again. The manner in which Mr. Thomson explains these two parts of the phenomena is, that the more watery portions of the entire surface, having more tension than those which are more alcoholic, drag the

latter briskly away, sometimes even so as to form a horizontal ring of liquid high up round the interior of the vessel, and thicker than that by which the interior of the vessel was wet. Then the tendency is for the various parts of this ring or line to run together to those parts which happen to be most watery, so that there is no stable equilibrium, for the parts to which the various portions of the liquid aggregate themselves soon become too heavy to be sustained, and so they fall down.

The same mode of explanation, when carried a step further, shows the reason of the curious motions commonly observed in the film of wine adhering to the inside of a wine-glass when the glass, having been partially filled with wine, has been shaken so as to wet the inside above the general level of the surface of the liquid; for, to explain these motions, it is only necessary further to bring under consideration that the thin film adhering to the inside of the glass must very quickly become more watery than the rest, on account of the evaporation of the alcohol contained in it being more rapid than the evaporation of the water. On this matter, Mr. Thomson exhibited to the Section a very decisive experiment. He showed that in a vial partly filled with wine, no motion, of the kind described, occurs as long as the vial is kept corked. On his removing the cork, however, and withdrawing, by a tube, the air saturated with vapour of the wine, so that it was replaced by fresh air capable of producing evaporation, a liquid film was instantly seen as a horizontal ring creeping up the interior of the vial, with thick-looking pendent streams descending from it like a fringe from a curtain. He gave another striking illustration, by pouring water on a flat silver tray, previously carefully cleaned from any film which could hinder the water from thoroughly wetting the surface. The water was about one-tenth of an inch deep. Then, on a little alcohol being laid down in the middle of the tray, the water immediately rushed away from the middle, leaving a deep hollow there, which laid the tray bare of all liquid, except an exceedingly thin film. These and other experiments, which he made with fine lycopodium powder dusted on the surface of the water, into the middle of which he introduced alcohol gently from a fine tube, were very simple, and can easily be repeated. Certain curious return currents which he showed by means of powder on the surface, he stated he had not yet been able fully to explain. He referred to very interesting phenomena previously observed by Mr. Varley, and described in the fiftieth volume of the *Transactions of the Society of Arts*, which he believed would prove to be explicable according to the principles he had now proposed.

VISION OF SURFACES.

SIR DAVID BREWSTER has read to the British Association a paper "On the Binocular Vision of Surfaces of different Colours." Professor Dove had published an account of some beautiful experiments in connexion with this subject some years ago. M. Dove showed in his paper that when different colours at the same real distance are regarded by the eye they appear to be at different distances; this is also the case when a white surface is compared with a black. Now M. Dove argues

if a white surface and a black one be stereoscopically combined, one of them must be seen through the other. Taking a figure for the left eye with a white ground, and a second figure of the same object on a black ground for the right eye, when these two figures are combined, a beautiful effect is observed: the figure starts into relief, and its sides appear to possess a shining metallic lustre. This is the case when the surface of each single object is quite dull and lustreless. On this experiment M. Dove founds a theory of lustre, supposing it to be produced by the action of light received from surfaces at different distances from the eye. An example of this is the effect observed on looking at varnished pictures: one portion of the light comes from the anterior surface of the varnish and the other from its posterior surface, the action of both of these conspiring to produce the observed lustre. The metallic lustre of mica is also referred to by M. Dove as an example of the same kind. In his present communication Sir David Brewster controverts the theory here laid down, and bases his objections on the following remarkable experiment:—where a white surface without definite boundary and a black surface of the same kind are regarded through the stereoscope, no lustre is observed. Sir David therefore infers that the lustre is due not to the rays from one surface passing through the other to the eye, but to the effort of the eyes to combine the two stereoscopic pictures.

ABSORPTION OF MATTER BY THE SURFACES OF BODIES.

"If (says Sir David Brewster) we smear very slightly, with soap, the surface of a piece of glass, whether artificially polished or fused, and then clean it perfectly with a piece of chamois leather, the surface, when breathed upon, will exhibit, in the most brilliant manner, all the colours of thin plates. If we breathe through a tube, the colours will be arranged in rings, the outermost of which is black, corresponding to the centre of the system of rings formed between a convex and a plane surface." In repeating this experiment on the surfaces of other bodies, Sir David found that there were several on whose surfaces no colours were produced. Quartz exhibited the colours like glass, but calcareous spar and several other minerals did not. In explaining this phenomenon, the author stated that the particles of the soap, which are dissolved by the breath, must either enter the pores of the bodies or form a strongly adhering film on their surface. This property of appropriating temporarily the particles of soap, becomes a new distinctive character of mineral and other bodies.—*Proceedings of the British Association.*

ON COMPLEMENTARY COLOURS. BY H. MEYER.

Without going into the consideration of the proposed explanations of the complementary colours, M. Meyer gives a few experiments by which the observation of these subjective colours is much facilitated.

If a narrow strip of gray paper be laid upon a coloured surface, this strip appears tinged with the complementary colour of the body on which it is lying. This experiment does not, however, always succeed

equally well, and is best performed with a green surface; if the strip of paper be white and a little broader, the complementary colour is only observed after long watching, or perhaps not at all. The complementary colour may, however, be produced *immediately and quite distinctly*, even with white strips of such breadth, that, without further assistance, they cannot show the complementary colour (several inches broad), by laying a leaf of fine, transparent writing-paper over the coloured surface and white paper. The white strip *immediately* appears covered with a tolerably uniform pale tinge of the complementary colour.

A sheet of coloured paper laid beside one of white paper does not allow the complementary colour to be observed upon the latter; and it is only when the coloured sheet has been looked at for some time, and the eyes are then alternately directed from the coloured surface to the white, that the strip of the latter lying next to the coloured surface is tinged with a somewhat intense complementary colour. But if a transparent sheet of writing-paper be laid over the coloured and white surfaces, the complementary colour immediately makes its appearance upon the latter, without any previous removal of the eye from one surface to the other. If the eye be directed to the margin of the white and coloured surfaces, the portion of the white surface lying next to the coloured surface appears more intensely tinged with the complementary colour than the parts lying at a greater distance; but if the white surface be examined by moving the eye, so that the different parts of the white surface may be represented one after the other upon the same part of the retina, the surface appears covered with a more uniform tint of the complementary colour.—*Poggendorf's Annalen*, vol. xcv.; *Philosophical Magazine*, No. 62.

OCULAR SPECTRES AND STRUCTURES.

A PAPER has been read to the Royal Society, on "Ocular Spectres and Structures as Mutual Exponents," by James Jago, A.B. Cantab., M.B. Oxon. The paper opens by stating that for want of a methodical elimination of ocular spectres from one another—a want which its aim is to meet—physiological optics remain to this day without any real foundation; and even when we have followed the rays of light through all the refracting media of the eye, we cannot safely assert what sensations belong to them until we have detected everything connected with the *percipient membrane* which may obstruct the action of light on it, or which may originate sensations *as of light* through other sorts of impulses. Our eyes in many important respects provide us with an opportunity for microscopical research that no optical instrument employed on the dead eye can rival. We may thus gather a variety of information, physical and physiological, solve points of ocular structure that escape other means of investigation, and bring a profusion of ingenious speculations to a termination, by showing that the phenomena (and this is especially true of the retinal phenomena) which have occasioned them are simply exponential of anatomical facts; and important physiological laws may be arrived at by like means.

The first step in the author's task is to determine the conditions

which render objects existing upon or within the eye visible by their shadows, and to obtain optical principles by which we may examine the interior of our own eye with facility, so as to recognise in what lenticular structure, and what part of it, the cause of any shadow or "diffractive image" resides. He shows that we may make every measurement of interest, may decide all the points just alluded to, at the instant, as it were, by mere inspection; and he illustrates his optical principles by appropriate experiments.

THE TRIPLE SPECTRUM.

SIR DAVID BREWSTER has read to the British Association a paper on the Triple Spectrum, which commences as follows :—

"At an early meeting of the Association I communicated to this Section an account of the experiments by which I endeavoured to establish the existence of a triple spectrum, that is, a spectrum which, instead of consisting of seven different colours, consisted of three spectra of equal length—red, yellow, and blue,—having different degrees of intensity in different parts, and their ordinates of maximum intensely incoincident. This paper, entitled 'A New Analysis of Solar Light,' was published in 1831, in the *Transactions of the Royal Society of Edinburgh*. The experiments were shown to some of the distinguished members of that body, who honoured them by the adjudication of the Keith Medal. Many years afterwards, Mr. Airy, Dr. Draper, of New York, and M. Melloni, who had failed in observing the phenomena which I had described, called in question the accuracy of my results. I replied successively to these different criticisms in the *Philosophical Magazine*, and I had reason to think successfully, as no rejoinder was made by any of these three parties. Dr. Whewell, however, who had never made an experiment on the subject, and the Abbé Moigno, who was equally guiltless of using a prism, relying perhaps upon Mr. Airy's experiments more than mine, or unwilling that Newton's analysis of the spectrum should be regarded as incomplete, denied the existence of a triple spectrum. It was in vain to reason with antagonists of this kind; and this was perhaps one of the occasions when hard-working men of science have to regret that the history of their labours has been given by individuals who have not wrought in the same field. Within the last few years the subject of the triple spectrum has been studied by two eminent individuals, M. Bernard, in France, and M. Helmholtz, in Prussia, both of whom have called in question the accuracy of my conclusions. To the observations of these two writers I did not think it necessary to reply; but being obliged to refer to the subject of the changes of colour produced by absorption, and consequently to the triple spectrum, in my *History of Newton's Optical Discoveries*, I found it necessary to notice the objections which had been made to it."

Sir David then submits a few of the remarks which he has there made upon these experiments of these two foreign observers. (For the details, see the *Athenæum*, No. 1158). The author then proceeds to reply to a "dogmatic decision" given by Dr. Whewell, at the previous meeting of the British Association, at Liverpool—"That the light at

the several parts of the solar spectrum (as arrived at by Professor Bernard), was simple and not compounded light; and that thus the view which had some years since been propounded, and which was still entertained by some, that the spectrum obtained by the prism was composed of several superimposed spectra, is proved to be unfounded, and must be abandoned." Sir David then concludes :—

"The doctrine of the Triple Spectrum, in place of being either startling or offensive, was received most favourably by artists of all kinds, who could not understand how there could be seven simple colours in the spectrum, while all these colours, and all the colours in nature, could be formed out of three—red, yellow, and blue; and it gave satisfaction to many scientific individuals, because it afforded a perfect explanation of the existence of seven colours in the spectrum which all pass into one another by imperceptible shadow.

"I may here mention it as a remarkable fact, and as a new argument in favour of the doctrine, that when the ordinate of the three dissimilar and incoincident curves, having their maxima different in magnitude and position, and representing the intensity of illumination at every point of the three spectra, should when combined give a single curve similar to that by which Fraunhofer represents the intensity of illumination in the ordinary spectrum. Had the doctrine of a triple spectrum, therefore, been a mere hypothesis, unsupported by the analysis of absorbing media, or by any other direct experiment, it would have been entitled to a generous reception from every optical student. Dr. Wollaston would have received it as the only explanation of his spectrum of four colours—red, green, blue, and violet—in which the yellow rays were wholly absorbed by reflexion from the azure sky. Dr. Young would have accepted it as an explanation of his spectrum, which was the same as Dr. Wollaston's, with the addition of a narrow line of yellow between the red and the green. Sir William Herschel would have regarded it as an explanation of his experiment, in which he saw the red of the spectrum changed in colour by reflexion from polished brass.

"And I may quote Sir John Herschel, the highest authority of them all, as believing (on the evidence of his own experiments, published in the *Edinburgh Transactions* and in his *Treatise on Light*) that the colours of the spectrum are really changed by absorbing media. When these great men are proved to have been the dupes of possible rays, of complementary deceptions, or of enfeebled light, I shall willingly submit to the same imputation. In concluding this notice, I may mention that none of the opponents of the triple spectrum have repeated my fundamental experiment made with an apparatus which I believe no person but myself possesses. I examine a pure spectrum divided into compartments by the action of thin plates of calcareous spar passing across a prism of the same substance. Each of these luminous compartments shades off into the adjacent dark spaces, and is in a different condition from the corresponding portion of the complete spectrum. When the proper absorbing media are applied to certain portions of this divided spectrum, I insulate a large portion of white light indecomposable by

the prism, and it stands beside a portion of red light as distinctly as an almond placed beside a cherry. This is an *experimentum crucis*, if one were wanting in favour of the doctrine of a triple spectrum—of the existence of three colours, red, yellow, and blue, at the same point of the spectrum.

"I may now leave the opponents of the triple spectrum to settle their differences among themselves. When allies quarrel, the common foe is sure of at least a temporary triumph. Messrs. Airy and Draper (for Melloni, a philosopher of original genius, cannot now assist them) may take the field in equal numbers against MM. Helmholtz and Bernard. The Prussian and French combatants may settle their difference in single fight; and Dr. Whewell and the Abbé Moigno—these soldiers of fortune, whose lance has been sharpened for every combination—might honourably quit an alliance in which they have been rather dupes than aggressors. I may now leave it to my friend Professor Wartmann, of Geneva, our greatest authority on the subject of colour-blindness, to determine which of all the parties in this controversy are afflicted with that optical disease."

THE EYE AS A CAMERA OBSCURA.

Dr. George Wilson has communicated to the Royal Society a paper "On the Extent to which the Theory of Vision requires us to regard the Eye as a Camera Obscura." The object of this communication was to combat the current theory of vision, as exercised by vertebrate animals, in so far as it teaches that the light which reaches the retina from without, thereafter passes through that membrane, and is absorbed by the pigment of the choroid behind it.

The author, after enumerating the arguments adduced in favour of this view, proceeded to state that a mass of evidence, daily accumulating, had established, beyond question, the certainty that light is reflected from the anterior layers of the retina and from the choroid, and so abundantly, that oculists take daily advantage of the fact to examine, by means of this light, the deeper internal structures of the eye.

This organ, accordingly, cannot be regarded otherwise than in a limited sense as a camera obscura, and the arguments in favour of the opposite belief were shown to furnish no substantial support of the current opinion. Thus, the eyes of albino *animals* were found to exercise vision perfectly, although destitute of *pigmentum nigrum;* and the presence of the *tapetum lucidum*, which acts like a concave metallic reflector in the eyes of many creatures, was shown to furnish no obstacle to sight, which, on the other hand, it rendered more acute when light was feeble. The supposed cross reflection of light within the eye was also shown to be a phenomenon which could rarely occur so as to disturb vision.

The author finally urged that the reflection of light from the bottom of the eye served important ends, especially in the lower animals. Those ends he held to be—

1. The return from the choroid of light through the retina, so as to double the impression on the latter.

2. The reflection of light on external objects, which was best seen in

creatures whose eyes are provided with *tapeta lucida*, and acted alike as an assistance to them in finding their food, and in the case of carnivorous nocturnal and marine animals, to their prey in escaping from them.

In the human subject it was contended that, in very faint light, reflection from the bottom of the eye would assist vision, and that the known delicacy of visual perception, which characterized those who had been long imprisoned in damp chambers or dungeons, afforded an example of such assistance. The author also insisted on the fact, that, as the reflected light is always coloured, so as in the human eye to be bright red, yellowish-red, or brownish-red, and in different eyes to a different degree; and as we add from our eyes coloured light to every object we gaze at, no two persons see the same colour alike, or will exactly agree in matching tints. The existence and importance of such a chromatic personal equation was dwelt on at some length.

ACHROMATISM OF A DOUBLE OBJECT-GLASS.

PROFESSOR STOKES has communicated to the British Association the following paper :—The general theory of the mode of rendering an object-glass achromatic, by combining a flint-glass with a crown-glass lens, is well known. The achromatism is never perfect, on account of the irrationality of dispersion. The defect thence arising cannot possibly be obviated except by altering the composition of the glass. It seemed worthy of consideration, whether much improvement might not be effected in this direction; but the problem which the author proposed for consideration was only the following :—Given the kinds of glass to be employed, to find what ought to be done so as to produce the best effect; in other words, to determine the ratio of the focal lengths which gives the nearest approach to perfect achromatism. Two classes of methods may be employed for this purpose. In the one, compensations are effected, by trial, on a small scale; in the other, the refractive indices of each kind of glass are determined, for certain well-defined objects in the spectrum, such, for example, as the principal fixed lines. The former has this disadvantage, that compensations on a small scale do not furnish so delicate a test as the performance of a large object-glass. The observation of refractive indices, on the other hand, admits of great precision; but it does not immediately appear what ought to be done with the refractive indices when they are obtained. After alluding to the method proposed by Fraunhofer for combining the refractive indices, which, however, as he himself remarked, did not lead to results in exact accordance with observation, the author proposed the following as the condition of nearest approach to achromatism :—that the point of the spectrum, for which the focal length of the combination is a minimum, shall be situated at the brightest part—namely, at about one-third of the interval D E from the fixed line D, towards E. The refractive index of the flint glass may be regarded as a function of the refractive index of the crown glass, and may be expressed with sufficient accuracy by a series with three terms only. The three arbitrary constants may be determined by the values of three refractive indices, determined for each kind of glass. On applying the

resulting formula to calculate r (the ratio of the chromatic changes of the indices of refraction) for the object-glass, for which Fraunhofer has given both the refractive indices of the component glasses and the value of r, which, as observation showed, gave the best results, and taking in succession various combinations, of three lines each, out of the seven used by Fraunhofer, the author found that, whenever the combination was judiciously chosen, the resulting value of r was the same, whatever might have been the combination, and equal to 1·980, which is precisely the value determined by Fraunhofer, from observation, as giving the best effect.

PHYSICAL FEATURES OF SATURN AND MARS.

CAPTAIN W. S. JACOB, H.E.I.C. Astronomer, in a paper communicated to the *Edinburgh New Philosophical Journal*, No. 2, illustrates the planet Saturn as seen at Madras, in the latter part of 1852, with the equatorial instrument constructed by Messrs. Lerebours and Secretan of Paris; the object-glass of which has an aperture of 6¼ inches, and a focal length of 88·6 inches, and whose defining power is of a high order. Other favourable circumstances were, the planet's proximity to the zenith, and the tranquillity and transparency of the atmosphere. The obscure ring was well brought out the first time it was looked for, and the fine line on the outer ring was also seen distinctly enough to allow of good measures being made with the filar micrometer; although, strange to say, its very existence is still questioned in some quarters, as it is not visible in some of the largest telescopes, such as the Poulkova Refractor; very neat definition, rather than a great amount of light being required for the purpose. The transparency of the obscure ring, exemplified by the planet's limb appearing through it, would seem to have been first noticed at Madras, being shown in a drawing taken on 22nd September, 1852, and forwarded to a friend in this country, in a letter dated 11th October. This ring, as seen across the planet, has a light umber-brown tint, and a filmy, smoky character; the division between the two principal rings (usually represented black) had nearly the same tint, while its outer edge was not sharply defined, but shaded off. No separation, either by a dark or bright line, could be discerned between the bright and obscure rings; on the contrary, the impression was that the shading in the former was produced by the latter over-lapping or enveloping its edge.

The planet was frequently examined, whenever the atmosphere was in a favourable condition, until April, 1854, the time of the writer's departure from India, without any change being perceptible, except that the peculiar features above described had become gradually rather more conspicuous, so as to be discerned with lower powers. This would arise partly from the rings appearing at a greater inclination, or more *open*, and partly, perhaps, from the eye becoming, through practice, more familiar with the details. After the first scrutiny, in August, 1852, no difficulty was ever experienced in making out any of the peculiar points above described, provided that the atmosphere was sufficiently tranquil to admit of using a magnifying power of 180 or upwards. The powers usually employed were 277 and 365.

Captain Jacob then illustrates his views of Mars, taken with the same instrument. The lower view, though the later in point of time, yet *precedes* the upper, as regards the longitude or angular motion of the planet, because its period of revolution is rather longer than that of the earth; the difference in longitude between the two is about 90°. The other faces do not present such striking features, but are nearly blank. Former engravings of the planet do not show any such distinct markings; at least the writer has not been fortunate enough to meet with any that could be recognised as likenesses. Mars will again be in a favourable position for observation in 1856; in 1858 he will be nearer still; and it is to be hoped that on these occasions still better drawings of him will be obtained.

KNOWLEDGE OF THE MOON'S SURFACE.

PROFESSOR C. PIAZZI SMYTH, taking advantage of the special attention paid to certain astronomical disquisitions, has called attention to a particular point connected with the Moon, which was first stated by the author of the *Plurality of Worlds*, and then made by him to prove that the moon must be uninhabited—leading to the conclusion that all the other planets are uninhabitable also. This point is, that "observations having been made on the moon abundantly sufficient to detect the change caused by the growth of such cities as Manchester and Birmingham, no such changes having been perceived, the theory of non-habitation may be indulged in."

But after having indicated the sort of appearance that those collections of human habitations would make when transferred to the moon, Professor Smyth proceeds to show that the registered and published observations of the moon are by no means sufficiently accurate to be used to test this question: and that they do show changes, and often to a far greater amount than the mere building of a lunar Manchester would occasion; but such changes bear the impress of error of observation. More powerfully still is this brought out, on comparing even the best of the published documents with some manuscript drawings of the Mare Crisium in the moon, recently made at the Edinburgh Observatory; and the author hopes that this statement of the imperfection of existing maps will lead to observers generally applying themselves to improve this important and interesting field of astronomy.—*Edinburgh New Philosophical Journal*, No. 2.

CHRONOLOGY OF THE FORMATION OF THE MOON.

PROFESSOR NICHOL, at the late Meeting of the British Association, at Glasgow, stated that, through the munificence of the Marquis of Breadalbane, he had been enabled to bring to bear on the delicate inquiries, whose commencement he intended to explain, a very great if not a fully adequate amount of telescopic power. A speculum of twenty-one inches, originally made by the late Mr. Ramage with the impracticable focal length of *fifty-five feet*, had, at the expense of that noble lord, been re-ground, polished, mounted as an equatorial, and placed in the Glasgow Observatory, in its best state, only about six weeks ago. Professor Nichol showed some lunar photographs, which

indicated the great light with which the telescope endowed its focal images, and entered on other details as to its *definition*. The object of the present paper is the reverse of speculative. It aims to recall from mere speculation, to the road towards positive inquiry, all observers of the lunar surface. To our satellite hitherto those very ideas have been applied, which confused the whole early epochs of our terrestrial geology, the notion, viz., that its surface is a *chaos*, the result of primary, sudden, short-lived, and lawless convulsion. We do not now connect the conception of irregularity with the history of the earth:—it is the triumph of science to have analysed that apparent chaos, and discerned order through it all. The mode by which this has been accomplished, it is well known, has been the arrangement of our terrene mountains according to their relation to time: their relative ages determined, the course of our world seemed smooth and harmonious, like the advance of any other great organization. Ought we not then to attempt to apply a similar mode of classification to the formations in the moon, hoping to discern there also a course of development, and no confusion of manifestation of irregular convulsion? Professor Nichol then attempted to point out that there appeared a practical and positive mode by which such classification might be effected. It could not, in so far as he yet had discerned, be accomplished by tracing, as we had done on earth, relations between lunar upheavals and stratified rocks; but another principle was quite as decisive in the information it gave, viz., the intersection of dislocations. There are clear marks of dislocation in the moon—nay, the surface of our satellite is overspread with them. These are the rays of light, or rather bright rays, that flow from almost all the great craters as their centres, and are also found where craters do not at present appear. Whatever the substance of this highly reflecting matter, it is evidently no superficial layer or stream, like lava, but extends downwards a considerable depth into the body of the moon. In short, we have no likeness to it on earth, in the sense now spoken of, except our great trap and crystalline *dykes*. It seemed clear, then, that the intersections of these rays are really *intersections of dislocations*, from which we might deduce their chronology. Can the intersection, however, be sufficiently seen?—in other words, is the telescope adequate to determine which of the two intersecting lines has disturbed or cut through the other? Professor Nichol maintained the affirmative in many cases, and by aid of diagrams, taken down from direct observation, illustrated and enforced his views.—*Athenæum*, No. 1456.

THE AURORA BOREALIS.

ADMIRAL SIR JOHN ROSS has read to the British Association the following paper "On the Aurora Borealis:"

The communication I had the honour of making to the British Association for the Advancement of Science at Belfast, on the interesting subject of the aurora borealis, was verbal; and, therefore, not entitled to a notice in the Association's valuable *Transactions* of that period; but, having subsequently repeated the experiments I then verbally mentioned, I can now confidently lay the account of them before the

public, trusting that, when taken into consideration, they will be found corroborative of the theory which I published in the year 1819, and which led to a controversy that shall be hereafter mentioned. It having occurred to me that, if my theory was true, namely, "that the phenomena of the aurora borealis were occasioned by the action of the sun, when below the pole, on the surrounding masses of coloured ice, by its rays being reflected from the points of incidence to clouds above the pole which were before invisible," the phenomena might be artificially produced; to accomplish this, I placed a powerful lamp to represent the sun, having a lens, at the focal distance of which I placed a rectified terrestrial globe, on which bruised glass, of the various colours we have seen in Baffin's Bay, was placed, to represent the coloured icebergs we had seen in that locality, while the space between Greenland and Spitzbergen was left blank, to represent the sea. To represent the clouds above the pole, which were to receive the refracted rays, I applied a hot iron to a sponge; and, by giving the globe a regular diurnal motion, I produced the phenomena vulgarly called "The Merry Dancers," and every other appearance, exactly as seen in the natural sky, while it disappeared as the globe turned, as being the part representing the sea to the points of incidence. In corroboration of my theory, I have to remark that, during my last voyage to the Arctic Regions (1850-1), we never, among the numerous icebergs, saw any that were coloured, but all were a yellowish white; and, during the following winter, the aurora was exactly the same colour; and, when that part of the globe was covered with bruised glass of that colour, the phenomena produced in my experiment were the same, as was also the Aurora Australis, in the Antarctic Regions, where no coloured icebergs were ever seen. The controversy to which I have alluded was between the celebrated Professor Schumacher, of Altona, who supported my theory, and the no less distinguished M. Arago, who, having opposed it, sent M. G. Martens and another to Hammerfest on purpose to observe the aurora, and decide the question. I saw them at Stockholm on their return, when they told me their observations tended to confirm my theory; but their report being unfavourable to the expectations of M. Arago, it was never published; neither was the correspondence between the two Professors, owing to the lamented death of Professor Schumacher. I regret that it is out of my power to exhibit the experiments I have described, owing to the peculiar manner in which the room must be darkened, even if I had the necessary apparatus with me; but it is an experiment so simple that it can easily be accomplished by any person interested in the beautiful phenomena of the aurora borealis.—*Athenæum*, No. 1457.

ANOMALIES IN BINARY STARS.

Captain W. S. Jacob has communicated to the British Association a paper "On certain Anomalies presented by the Binary Star, 70 Ophiuchi." This pair has been long known to astronomers as a binary system, but the exact orbit is yet in doubt, although nearly a whole revolution has been completed since it was first observed by Sir W. Herschel in 1779. All the orbits that have been computed fail at

certain points in representing the observed positions, and those which best represent the angles fail entirely as regards the distances. The most remarkable point is, that even in those orbits which agree best with observation, the errors in the angles assume a *periodical* form, retaining the same sign through a considerable space of time. An orbit has been computed with a period of 93 years, in which the errors are + from 1820 to 1823, — with one exception from 1823 to 1830, doubtful in 1830 to 1832, and from 1833 to 1842 all +, after which they continue for the most part —. This sort of error must depend upon some law; it *might* arise from a change in the law of gravitation, but may be accounted for more simply by supposing the existence of a third opaque body perturbing the other two. Such bodies have already been suggested to account for irregular motions of apparently single stars, such as Sirius and Procyon. The body in this case, if supposed to circulate as a planet round the smaller star, need not be very large, as the deviation from the ellipse does not exceed about 0″·1. Assuming the small star to describe a secondary ellipse in which $a = 0''\cdot08$, $\epsilon = ''\cdot15$ and $\omega = 200°$, and applying corresponding corrections to the computed positions, the average error in the angles is reduced from 50′ to 37′, and in the distances measured subsequent to 1837, from 0″·14 to 0″·11, or by about ¼; while the maximum errors are also reduced in about the same proportion. There is, therefore, *primâ facie* evidence for the existence of such a body, and it is desirable that the fact should be still further tested by careful observation. The subject possesses an additional interest at the present time, in reference to the opinion brought forward in the Essay "*Of the Plurality of Worlds*," on the *impossibility* of double stars having attendant planets.—*Athenæum*, No. 1457.

TO ASCERTAIN THE DIRECTION OF THE WIND.

Mr. T. Stevenson, Civil Engineer, has communicated to the *Edinburgh New Philosophical Journal*, No. 3, the following accurate and easily applied method of ascertaining the Direction of the Wind, by observing the reflected image of the clouds.

In making some experiments, in which it was necessary to know accurately the direction of the wind, Mr. Stevenson was much annoyed by the insufficiency of vanes and all ordinary methods employed for that purpose. The under currents of air are so numerous and conflicting, more especially in towns, where the houses are lofty, that the author has seen it proclaimed to be due east at one end of a street, while at the other it seemed with equal certainty to be coming in a westerly direction.

In this dilemma, it occurred to him that a more accurate conclusion might be arrived at, by observing the direction of the drifting clouds when reflected in a mirror.

At first, Mr. Stevenson used a common mirror, placed horizontally, so as to have the sky reflected in it; and having fixed upon a cloud, he watched its progress in the mirror, taking care to keep the eye steadily in one position, and carefully marking the track of the cloud upon the glass with a pencil of soap. When this was done, it was easy, by

placing a compass on the mirror, to ascertain the direction of the wind from that of the cloud's path traced on the glass. A more convenient and portable instrument has since been constructed, consisting of an ordinary compass having a silvered disc in the centre of its covering glass of such a size as to allow the points of the needle and the graduated circle of the compass to be seen beyond it. The glass has cross lines cut upon it, passing through the centre, and drawn so as to correspond with the cardinal points marked on the divided circle. The whole compass can be made to revolve in the horizontal plane, upon a point projecting from the bottom of the outer case. When the cloud which is to be observed has been selected, as near the zenith of the observer as possible, the compass should be gradually turned round until one of the lines upon the glass remains coincident with one well-defined edge of the cloud as it passes across the field of view. The angle indicated by the magnetic needle being then read off, the azimuthal bearing of the cloud's track from the magnetic north is at once ascertained.

The convenience of this instrument might be increased by having an eye-piece attached to it, capable of being fixed in such a manner as to point to the intersection of the cross lines in the centre of the circle, so that the eye may be kept steadily in the same direction. By means of an apparatus on the principle of a camera obscura, the direction of the wind could be easily ascertained by observing the compass bearing of the cloud's track. And in the absence of better instruments, the reflection by a mirror ought certainly in all cases to be preferred to the indications of vanes, whose action must always be vitiated more or less by friction, and perhaps by other causes, besides being liable to be acted upon by currents which have been distorted from their true direction by obstructions due to houses, trees, and the configuration of the earth's surface. The changes of wind and weather so characteristic of our climate, might, perhaps, be more certainly or more speedily predicted by comparing the motions of the clouds in the higher regions of the atmosphere, with those nearer the earth's surface, than from information derived from other sources. Mr. Stevenson has observed a change of wind apparent in the direction of the high clouds for two days before the currents near the earth's surface were affected, although they ultimately assumed the same direction.

THE RADIANT SPECTRUM.

From an extensive series of experiments, Sir David Brewster concludes that every luminous ray in the Spectrum is accompanied by invisible rays of greater refrangibility than the luminous ray itself; that these rays are rendered visible by the dispersive action of the solids and fluids on which they are incident, and by which they are refracted, reflected, or transmitted. He believes that these invisible rays occupy the same place in the spectrum as the chemical rays, and that they are probably connected with the phenomena of phosphorescence.—*Proceedings of the British Association.*

ON THE ACTION OF THE VIOLET AND ULTRA-VIOLET INVISIBLE LIGHT. BY W. EISENLOHR.

THE phenomenon described by Stokes under the name *fluorescence*, led me to the supposition that this was caused by the interference of the shorter system of waves, blue-violet and ultra-violet (for the sake of shortness, the chemically-acting invisible rays of the spectrum may be so designated). I think, with many others, that the eye has the greatest sensibility for a certain duration of vibration (the yellow light), and that it is the more sensitive for longer or shorter waves, the more these differ from the medium light in their depth or height.

Light itself consists of the visible systems of waves, and besides these, of such as are longer than red and shorter than violet. As the combination of two tones is always deeper than each single one, out of which the compound tone arises, so from the interference of yellow and blue there can result only light of greater length of undulation, and not violet light. Now, since red has the longest undulations of the visible light, the combination of red and yellow waves of light can only give a deeper tint than red, and consequently no visible light. A fluorescence in the dark space of the spectrum near the red is not therefore to be expected. It is quite otherwise at the other end of the spectrum. The ultra-violet is the light acting in the dark space of the spectrum near the violet; its existence could only be shown by its chemical action, before the wonderful discovery of Stokes. It consists of countless systems of undulations, the lengths of which, differing among themselves, have all a shorter duration than the violet light. Through their interference, waves of greater length than their own result; and by their great variety, tints of combination no less numerous; hence, in many cases, all kinds of visible light, or white.

In other cases, a certain colour prevails in the mixture of the tints of combination, which will partly arise from the length of the original waves, and partly from the distance of the reflecting layers of atoms of the fluorescent body.*

Starting from this view, I have made experiments to find sources of light in which high tints prevail, in order to test this idea. Violet and blue glasses, through which the sunlight was admitted into the room by means of a heliostat, separating single parts of the entire spectrum from the rest, and causing the light thus obtained to penetrate into the fluorescent bodies, proved, at least, not the contrary of my supposition. I ascribe the cause of the partially slight success to the circumstance, that I possessed no blue and violet glasses of sufficient purity, which, on that account, allowed fewer of the more intensely acting rays to pass through. At last, the violet light occurred to me, which results in the so-called electric egg when it is exhausted of air. I tried its action on fluorescent bodies, and was delighted to see that it produced some of the appearances described by Stokes, with a splendour which I have never seen with the most beautiful experiment by means of the

* Of course the comparison between the tone of combination, and the light produced by various kinds of ultra-violet or other waves, must not be taken literally, for otherwise the number of vibrations of the resulting colour must be equal to the difference in the number of vibrations of the original rays.

spectrum. Paper, on which a design had been made with a solution of sulphate of quinine, showed at a distance of ten to twelve feet from the oval receiver in the dark chamber, all the details of the design in the most beautiful white on a *deep* violet ground. Ruhmkorff's induction apparatus is extremely convenient for the production of the electric light in the receiver, when the latter is almost exhausted of air. The appearance is so striking, as to lead to the belief that the writing or design on the paper is itself shining and sparkling.

Hence, in my opinion, it follows,—1. That the violet light produced *in vacuo* is mixed with a large quantity of invisible ultra-violet rays. 2. That out of the ultra-violet rays of the so-called northern light invisible to the naked eye, there results by interference in fluorescent bodies a quantity of visible light, and that therefore this light, reflected from the surface of the paper which has been marked with quinine solution, appears brighter than direct light; that therefore, out of the ultra-violet light invisible to the naked eye, there is produced by mechanical means actual light. 3. That the so-called northern light has the strongest chemical action.

A further conclusion is, that the light *in vacuo* of Ruhmkorff's apparatus, or even that of the electric machine, is a much more powerful agent for testing the fluorescence of bodies than any hitherto employed.

I may here mention that I am still engaged on this subject, and reserve to myself further communications. The short time at my disposal compels me to limit myself to the statement, that a thick white glass in the dark chamber appears of a clear and splendid gray.

I scarcely doubt that the white *colour* of the electric light in air has also its explanation in the combination of the higher systems of waves, which are formed in consequence of the manifold reflexion on the atoms of air, and the consequent interference. Even the sun's rays are, according to Sondhaus, violet, and we see the sun, as it appears to us, only through a mixture of tints, whose production can be explained by the combination of the shorter systems of rays of the violet light.—*Poggendorff's Annalen*, vol. xciii.; *Philosophical Magazine*, No. 57.

THE MOVEMENT OF ATMOSPHERIC AIR IN TUBES.

Dr. Chowne has communicated to the Royal Society an account of some "Experimental Researches on the Movement of Atmospheric Air in Tubes," which bear very materially on the subject of ventilation. It is printed in vol. vii. of the *Proceedings of the Royal Society*, p. 466. The object was to ascertain whether the ordinary state of atmospheric air, contained in a vertical cylindrical tube, open at both ends, and placed in the still atmosphere of a closed room, is one of rest or of motion; and if of motion, to investigate the influences of certain changes in the condition of the atmosphere which either produce, promote, retard, or arrest the movement.

The experiments would seem to demonstrate that the ordinary condition of atmospheric air within vertical tubes, open at both extremities, is one of continual upward movement:—

"If the atmosphere were a strictly homogeneous elastic fluid, and in

a state of perfect equilibrium, any portion of it contained in a vertical tube would of course be perfectly stationary, unless some adventitious cause produced disturbance of its equilibrium. But our atmosphere being a mixed fluid, and the aqueous vapour being of a much lower specific gravity at all atmospheric temperatures than the compound of which it forms a part, it is constantly rising within a tube, as in the free air; entering at the lower, and making its exit at the upper orifice of the tube.

"The experiments appear further to demonstrate, that the presence of aqueous vapour in the atmosphere is essential to the production of the current within the vertical tubes; since, by the abstraction of vapour from the air by quick-lime, the rotations of the discs were invariably either diminished or caused to cease; while, on the other hand, when the proportion of aqueous vapour in the air was increased, the currents and the rotations of the discs were simultaneously accelerated.

"In concluding the details of these experiments, the author considers that they all tend to prove the existence of an upward current, under the circumstances described in the commencement of this paper.

"They moreover yield a series of results, which he hopes the Society will deem to be not without interest.

"These results show it to be probable, if not certain, that the ordinary temperature of air within tubes, under the circumstances in which these were placed, is higher than of that external to them, all other relations of the tubes and surrounding objects being the same: they also show that in eight instances, when the thermometers indicated an equality of temperature within and external to the tube, the rotations of the discs still continued; and that when four coils of tape, moistened with water, were applied round the external surface of the tube, the rotations of the disc did not wholly cease.

"They also show, that when the atmosphere of the room, in which the tubes were immersed, contained a larger or smaller proportion of aqueous vapour, all other things being equal, the discs revolved with more or less velocity; but that when the atmosphere was deprived in a great degree of aqueous vapour by the presence of quick-lime, the thermometric state in all other respects remaining the same, the revolutions of the discs ceased.

"Adverting to the indications cited above, of a minute excess of temperature in the interior of the tubes, and assuming that even that slight excess would be sufficient to rotate the discs, still the rotations diminished or ceased in proportion as the aqueous vapour was withdrawn.

"Any increase of temperature which might have been produced by the quick-lime would have had a tendency rather to increase than diminish the revolutions of the discs, but we have seen that the abstraction of the vapour entirely arrested their rotation.

"With regard to the specific influence of each of the circumstances and agents most probably concerned in producing the phenomena described above, such as protection of the air within the tube from lateral expansion and mechanical agitations, to which the external air is exposed; gaseous diffusion; the unequal specific gravity of air and

vapour; and the subtle operations of temperature at all times, the author is fully conscious that he has not ascertained their respective values."

MAGNETISM OF IRON SHIPS.

The Rev. W. Scoresby, D.D., has communicated to the Royal Society a paper "On the Magnetism of Iron Ships, and its accordance with Theory, as determined externally, in recent Experiments."

In a work in the Society's library, entitled *Magnetical Investigations*, it was shown, by deductions from an elaborate series of experiments on plates and bars of malleable iron, that the magnetic condition of iron ships should, theoretically, be conformable to the direction of terrestrial induction whilst on the stocks; and the *retentive* quality, which is so highly developed by virtue of the hammering and other mechanical action during the building, should be so far fixed in the same direction, as to remain after the ships might be launched, until disturbed by fresh mechanical action in new positions of their head or keel. In this view, taking, for instance, the condition of the middle, or the main-breadth section of a ship on the stocks, the magnetic polar axis should assume the direction of the dipping-needle (with an equatorial plane, or plane of no-attraction at right angles to it), passing through or proximate to the centre of gravity of the iron material in such section. Thus every ship should have a characteristic magnetic distribution, primarily, dependent on her position whilst on the stocks; so that, being built with the head north or south, the *equatorial plane* should appear externally on the same horizontal level, the *polar axis* only being inclined from the vertical, in correspondence with the direction of the axis of terrestrial magnetism.—*Magnetical Investigations*, vol. ii. pp. 331, 332.

It was also inferred, that whilst such individuality of the magnetic distribution would be rendered *retentive* on the same principles as this quality of magnetism is developed in bars or plates of iron by mechanical action, so the axial direction of the ship's magnetism would be *liable to change*, under mechanical action, in new positions of the ship's head, or under new relations of terrestrial magnetism, just as the retentive magnetism is liable to change in bars or plates of iron if hammered, vibrated, or bent whilst held in new positions.

And it was further inferred, that the analogy with plates and bars might be expected to hold, notwithstanding the numerous pieces of which the ship's hull may be composed, because, in experiments, on combining short magnets into long series, or submitting piles of short bars of iron to terrestrial induction, it was found that no material difference in the effects occurred betwixt a *single* steel magnet of a given length, or a *single* bar of iron, and the same substance and dimensions combined in short or small pieces in contact. Hence it was considered that an iron ship should exhibit in its general fabric the characteristic phenomena of one undivided mass, or a unity as a magnetic body.

These anticipations, it will be seen (published betwixt three and four years ago), have, so far as we have now time to elucidate them, had

verifications, in actual experiments on iron ships, as beautiful as they are conclusive.

In the case of the *Elba*, an iron ship of 200 feet in length, built recently on the Tyne, the magnetic condition before launching, which I was invited to investigate by Mr. Robert Newall, the owner, was found satisfactorily accordant with theory. Her head pointed south a few degrees westerly, and her lines of no-deviation (indicative of the position of the magnetic equatorial plane) were at a small distance in elevation different on the two sides, that of the starboard side being the highest. Proceeding in a direction at right angles to the dip, and passing through, or near to, the ship's general centre of gravity, the lines of no-attraction (descending forward) came out near the junction of the stem with the keel. And *there*, it was remarkable, as I had suggested as probable to Mr. James Napier, of Glasgow, before making any experiment, there was found a departure from the ordinary regularity of the lines of no-attraction in a considerable downward bend.

Towards the stern, the equatorial lines rose out of and came above the iron plating of the *top-sides*, about 40 feet from the taffrail; thus giving to the *after-part* of the ship a uniform northern polarity. The ship, consequently, had become a huge simple magnet—the north pole at the stern and the south at the head. The attractive power, as was expected, was highly energetic. At the distance of 50 feet, a compass on the level of the keel, at right angles to it abreast of the stern, was deviated to an extent of above 10°; at 100 feet distance the ship's magnetism caused a deflection of about half a point; and at 150 and even 200 feet there was a very sensible disturbance!

In the case of the *Fiery Cross*, built at Glasgow and launched in January last (a case which I have elsewhere referred to), the lines of no-deviation, as taken for me by Mr. James Napier, were still more rigidly in accordance with theory,—the difference of elevation of the observed lines of no-deviation at the main-breadth section agreeing with calculation, theoretically to within an inch or two. In the other case, that of the *Elba*, a slight discrepancy as to the comparative level of the lines of no-attraction on the two sides, might, perhaps, be satisfactorily explained by the proximity and somewhat disturbing influence of another iron ship (advanced only to the frames or angle irons) on the port side of her.

In the case of the *Elizabeth Harrison*, a large iron ship built at Liverpool, the first I had carefully examined, the correspondence of the magnetic polar axis and equatorial plane with those of terrestrial action was equally characteristic and conclusive.

Hence we may perceive a sufficient reason for some of the peculiar phenomena in iron ships of the compass disturbances and their changes. We may see why a ship built with her head easterly or westerly, and having the polar axis inclined over 18° or 20° to the starboard or port side, should be *particularly liable to compass changes*, if severely strained or struck by the sea with her head in an opposite direction. We see why the compasses of the *Tayleur* should have been exposed to such a change as appears to have taken place in her lamentable case.

We see in the case of the *Ottawa** (one I have elsewhere referred to), why a heavy blow of the sea, with the ship heeling and her head pointing eastward, would be likely to produce a change in her magnetism, when her previous magnetic distribution was solicited by terrestrial action in an angle of 30° or 40° of difference. And we see why the *deviations* of the compass in iron ships should, differently from those of wooden ships, be sometimes *westerly* and sometimes *easterly* in ships built and trading in home latitudes; for here, whilst in wooden ships, where the iron work is in detached masses, the ship can have but little, externally, of the character of a true magnet, and can possess but small comparative differences from the position of her head whilst building; in iron ships, on the converse, where the ship is rendered by percussive action a powerful and, *retentively*, true magnet, her deviating action must be expected to be different, as the polarity of the head or stern may differ in denomination, or as the ship's magnetic polar axis may happen to lie over to starboard or port.

As an objection might be made to deductions from experiments on simple individual bars or plates of iron being applied to the case of iron ships built up of thousands of pieces, I have repeated the experiments, substituting for an entire plate or bar of iron a plate about 18 inches long and 3 broad, made up of numerous separate plates, and combined in the manner of the plating of iron ships. The compound or combined plate of some eighteen or twenty pieces yielded, under percussion, vibration, or bending, results precisely similar to those obtained by the use of single plates or bars.

PROBABLE MAXIMUM DEPTH OF THE OCEAN.

MR. W. DARLING has propounded to the British Association the theory, that as the Sea covers three times the area of the land, so it is reasonable to suppose that the depth of the Ocean, and that for a large portion, is three times as great as that of the highest mountain.—*Athenæum*, No. 1456.

* Where the compass suddenly changed two points.

Electrical Science.

ELECTRIC POLARITY.

VOLPICELLI has been making use of Metallic and other kinds of Rods in a series of experiments, from which conclusions are drawn "very favourable to the idea of an Electric Polarity pre-existing in the molecules, and manifested by the perturbations produced in the molecular condition." Angström has inquired into the phenomena of the Spectrum of the Electric Spark, and found a remarkable difference from those of the solar spectrum; and in some of the effects an approach towards an explanation of the colour of double stars. Tried in various gases, it was noticed that, "in the oxygen spectrum, the greatest number of bright lines occur in the blue and violet; in the nitrogen spectrum, in the green and yellow; and in the hydrogen spectrum, in the red."—*Chambers's Journal.*

ELECTRIC QUALITIES OF MAGNETIZED IRON.

PROFESSOR W. THOMSON has observed to the British Association, that the ordinary phenomena of Magnetism prove that there is a difference between the mutual physical relations of the particles of a mass of iron, according as it is magnetized or in an unmagnetic condition. Joule's important discovery, that a bar of iron, when longitudinally magnetized, experiences an increase of length, accompanied with such a diminution of its lateral dimensions as to leave its bulk unaltered, is the first of a series by which it may be expected we shall learn that all the physical properties of iron become altered when the metal is magnetized, and that in general those qualities which have relation to definite directions in the substance are differently altered at different inclinations to the direction of magnetization. In the present communication, the author described experiments he had made—with assistance in defraying the expenses from the Royal Society, out of the Government grant for scientific investigations—to determine the effects of magnetization on the thermo-electric qualities, and on the electric conductivity, of iron.

MEASUREMENT OF ELECTRIC POTENTIALS AND CAPACITIES.

PROFESSOR W. THOMSON has described to the British Association three instruments:—The first, a Standard Electrometer, designed to measure, by a process of weighing the mutual attraction of two conducting discs, the difference of electrical potentials between two bodies with which they are connected; the second, an Electroscopic Electrometer, which may be used for indicating electrical potentials in absolute measure in ordinary experiments, and probably with advantage in observations of atmospheric electricity; and the third, for which a scientific friend has suggested the name of Electro-platymeter, an instrument which may be applied either to measure the capacities of

conducting surfaces for holding charges of electricity, or to determine the dielectric inductive capacities of insulating media.

APPARENT MECHANICAL ACTION DURING ELECTRIC TRANSFER.

A PAPER on this subject has been communicated to the British Association, by Mrs. Crosse, widow of the late Mr. Andrew Crosse, whose startling experiments in Electricity have from time to time been recorded in our *Year-Book*.

Dr. Playfair stated that at the last meeting of the Association, Mr. Crosse had read a communication on some phenomena which took place in the electric current: it was objected on that occasion, that it was possible the gold which was carried over might have been impure gold; and that it was owing to a solution of copper that was in the gold that these mechanical phenomena ensued. Mrs. Crosse, with a desire to show the accuracy of her husband's experiments, had since his death repeated the experiment with pure gold, and obtained the results mentioned in the communication.

ALLOTROPIC MODIFICATIONS OF CHLORINE AND BROMINE.

DR. ANDREWS, in an important paper read by him to the British Association, on Allotropic Modifications of Chlorine and Bromine to the Ozone Form of Oxygen, shows that chlorine and bromine, when submitted to a series of electric discharges, acquire the power of dissolving platinum, which they do not possess in their ordinary state. By agitation with the water active chlorine is absorbed, and converted into its ordinary state.

EFFECT OF MECHANICAL STRAIN ON THE THERMO-ELECTRIC QUALITIES OF METALS.

PROFESSOR W. THOMSON having found that iron and copper wire, when stretched by forces insufficient to cause permanent elongation, had their thermo-electric properties altered during the continuance of the strain in a direction opposite to the effects which Magnus had obtained when wires are permanently elongated by passing through the draw-plate, has examined the effect of the longitudinal and lateral compression and extension, and he finds that the peculiar thermo-electric qualities produced are those of a crystal. As regards iron, the general conclusion is that its thermo-electric quality when under pressure in one direction deviates from that of the unstrained metal towards bismuth for currents in the direction of the strain, and towards antimony for those perpendicular to it, and the residual thermo-electric effect of the permanent strain is the reverse of that which subsists during application of the strain.—*Proceedings of the British Association.*

THE VOLTAIC BATTERY FOR MILITARY PURPOSES.

CAPTAIN WARD, of the Royal Engineers, has published an important paper "On the Application of the Voltaic Battery to Military Purposes," in which he shows how the methods are to be applied with the greatest power and economy. He prefers a small Grove's battery, and a fuse of platinum-wire, as this will burn even should the insulation

not be quite perfect, which cannot be said of other fuses. By adapting a helix to his wire, he explodes a charge at a distance of four miles, and he has fired eight guns at once. He points out, moreover, the use which may be made of this contrivance in communicating signals; and it becomes clear that henceforth electricity will enter into the means and appliances of war. Colonel Portlock, in his notes to the paper, remarks: "Mr. Wheatstone has explained to me many novel and ingenious contrivances; such, for example, as the introduction of a small clock-movement, by which the discharge should be effected at any interval of time, from a few minutes upwards, so that a charge of powder might be left to explode of itself at a definite time, or if enclosed in a floating-case, might be allowed to drift against a ship or other object, and would explode at the instant the circuit became closed by the action of the clock-work." And it is now known that gunpowder can be fired "by a current induced by a magnet, without the intervention of a voltaic battery."—*Chambers's Journal.*

NEW EXPLOSIVE APPARATUS.

THE Major of Engineers, M. Ebner, has laid a Report before the Austrian Academy of Sciences, which relates to the solving of the question, "Whether electricity or voltaism is preferable for the exploding of mines in quarries?" &c. The Report gives preference to the former, because the amount of effect of the voltaic battery depends on the quality of the conductor through which it has to act; and whenever a great effect (force) is required, the alternative presents itself, either to use colossal batteries, or costly conductors of the usual large dimensions. Electricity, on the contrary, operates in consequence of a mechanic action, without the co-operation of the conductor; and as the resistance does not exist, conductors of cheap material and small power are sufficient. The apparatus adopted now by the Austrian Corps of Engineers, consists of two discs or plates, of 12 inches diameter, and the charge is made without the conductor being employed, by the mere placing of a point between the plates. A smaller apparatus can be carried on a strap on the back of a man. The conductor consists of soft brass wire, of half an inch thickness, and each apparatus is furnished with 2000 fathoms of plain wire, and 400 fathoms of wire coated with gutta percha, and also materials for constructing isolated conductors. The explosive substance, a mixture of sulphur, antimony, and chloride of potash, can be made with ease, and placed in the form of a cartridge at any part of the conducting line. With these apparatuses explosions have been effected at a distance of 1½ German leagues, and fifty mines exploded simultaneously, on a line of 100 fathoms. Under water explosions were effected at a distance of 400 fathoms, the conductor extending to the length of 500 fathoms. The effects of these machines are independent of seasons and weathers. At the explosions made under water in the Danube, near Grein, and the marble quarries near Neustadt, it has been used for two years, without the loss of a single life. According to a signal, the explosion is made when the excavators and others are absent, and bore holes are mostly exploded simultaneously.—*Mechanics' Magazine*, No. 1688.

EXPERIMENTS WITH A LARGE ELECTRO-MAGNET.

Professor W. Thomson has described to the British Association these experiments made by Mr. Joule. The relation of the exciting force to the sustaining power of a magnet was the subject which it was the author's desire to examine, the laws arrived at being very divergent from those usually received. The soft iron made use of in this magnet was of such a nature that it always—probably on account of intense magnetization on some former occasion—retained a residual polarity which was always in the same direction. The magnet might be excited by a current which developed a polarity opposed to the residual one; but, on the interruption of the current, the latter reappeared. With high power, the lifting power fell short of being proportional to the square of the current; but with feeble excitation, Mr. Joule found the sustaining force to vary as the fourth or fifth power of the current strength employed.

Dr. Robinson gave an account of some of his own experiments on this subject, which confirmed those of Mr. Joule. The magnet made use of in his experiments consisted of two upright pillars of soft iron, with a moveable crosspiece of the same metal, which enabled him to vary the length of the limbs of the magnet. To determine the lifting power, a keeper, or sub-magnet, accurately planed, was placed across from pole to pole of the magnet, and, by a suitable mechanical arrangement, the force necessary to separate it from the excited magnet was determined. An approach to the point of magnetic saturation soon manifested itself, and, in this respect, the experiments of Professor Robinson were quite confirmatory of those of Mr. Joule.—Professor Tyndall remarked that he had sometimes been surprised to observe the comparatively low power of excitement in Mr. Joule's experiments at which the approach to magnetic saturation was exhibited. In Müller's experiments, where thick bars of iron were used, it required very strong excitation to produce the falling off, from the law that the magnetic attraction is proportional to the square of the exciting current. In Mr. Joule's experiments masses of soft iron were made use of, of far greater size than those used by Müller, but nevertheless the falling off from the law alluded to soon exhibited itself. In the remarks which had been brought before the Section, the shape of the magnet was omitted as an element in the question; but, in all probability, it would be found that if one of the limbs of Dr. Robinson's magnet were employed alone as a straight bar, its magnetism being measured by its action upon a freely suspended magnetic needle, instead of by its lifting power, the magnetic saturation of the bar would be much more difficult of attainment. Or even preserving the form of experiment made use of by Dr. Robinson, and introducing a plate of non-magnetic matter one-tenth or one-hundredth of an inch in thickness between the keeper and the magnet, a totally different law of lifting power would be obtained; the magnetic attraction in the last case would preserve its proportionality with the square of the current for a much longer period. A current which would appear to saturate the magnet in Dr. Robinson's experiments would not saturate it in the latter case; and there does not appear to be any sufficient reason for accepting the latter result in preference to

the former as expressive of the absolute capacity of the magnet for magnetization.—Dr. Robinson observed in reply, that he believed his method of experiment preferable to that suggested by Professor Tyndall for the special object in view. He regarded the disruption of direct contact better calculated to throw light on the true state of the magnet than the separation of the keeper where an interval existed between it and the magnet. He had actually introduced such an interval as that spoken of by Professor Tyndall, and it was true that he had found a totally different law from that arrived at when magnet and sub-magnet were in contact.—*Athenæum*, No. 1456.

RUHMKORFF'S APPARATUS.

Professor Faraday has explained at the Royal Institution, the action of Ruhmkorff's Apparatus, by which the effects of induced electricity are most strikingly exhibited. Mr. Ruhmkorff is a philosophical instrument-maker at Paris, who has contrived by the application of well-known principles, and by a new combination and enlargement of the induction coil, to produce from voltaic electricity some of the beautiful effects of the electricity excited by the most powerful machines; and thus to show most clearly the identity of the force excited by friction and by chemical action. The apparatus consists of a primary coil of copper wire, round which there is wound a large quantity of finer covered wire; and by sending a voltaic current through the first coil, electricity is induced in the second, though no portion of the voltaic current passes through it. This "secondary current," as it is called, possesses an intensity resembling that excited by the electrical machine. The induction of an intensity current in a second wire was discovered twenty years ago by Professor Faraday, who exhibited on the lecture table the original apparatus, by means of which that effect was produced. The induced electricity perceived on making contact with the voltaic battery is of the opposite kind to that excited on breaking contact, and Professor Faraday stated that the cause of there being no observable effect excepting at the moments of making and breaking contact was that the two opposing currents being equal in force, they neutralized each other. By a mechanical arrangement, which those who are acquainted with a common medical coil apparatus will understand, the contact is made and broken automatically with immense rapidity, and by this means the two electricities of the secondary current are separately brought into action. Ruhmkorff's apparatus is indeed little more than a greatly enlarged medical coil machine. The flood of electricity developed by this apparatus was exhibited in many beautiful experiments. When a jar coated inside with tin-foil was placed within the exhausted receiver of an air-pump, and one end of the second wire was connected with the inside of the jar, and the other end with the metal plate of the pump, there was a copious outpouring of purple light from the interior of the jar, accompanied by concentrated electric flashes, which varied in intensity as the strength of the voltaic battery was increased or diminished. Another remarkable exhibition of this condition of electric force was its passage in a succession of sparks between the ends of two wires. The sparks succeeded each

other so rapidly as to be not separately distinguishable when the wires were stationary, but on moving them about each spark was distinctly visible; the optical effect, in consequence of the short duration of the electric spark, being the reverse of that when a continuous light is in motion. Various modifications of Ruhmkorff's coil have been made by Mr. Grove and others, to increase its intensity effects, and to make the kind of electricity evolved approach still more closely to that excited by friction. In one of the arrangements shown by Professor Faraday, in which the secondary wire was connected with the interior of a Leyden jar, the positive and negative electricities of the secondary current were exhibited separately, and producing different effects; one being intensified by passing through the jar, and the other being in its ordinary condition. The sparks emitted by the intensified current were much more brilliant, and made a louder sound than the other, and the actions of the two currents were also different; for the former pierced holes through paper, whilst the latter set the paper on fire, and the ordinary current ignited gunpowder, which the other merely threw aside. Professor Faraday observed, in conclusion, that the extraordinary phenomena exhibited by Ruhmkorff's apparatus open new fields for discovery, which, if he were a younger man, he should have eagerly investigated, and he trusted that others who had their minds directed to the subject would be able to elicit by the observation of those phenomena many important truths in electric science.

DECOMPOSITION OF WATER.

PROFESSOR ANDREWS, of Belfast, has read to the British Association a paper "On the Polar Decomposition of Water by Frictional and Atmospheric Electricity." By an ingenious arrangement, the author was enabled to show that water is decomposed by the common machine; and also, by using an electrical kite, he was able, in fine weather, to produce decomposition, although so slowly, 1-700,000th of a grain of water was decomposed per hour.

NATURE OF CONDUCTION.

PROFESSOR FARADAY has illustrated at the Royal Institution a disputed question in Electricity respecting the Nature of Conduction—a question which has engaged attention for at least twenty years, and still remains in doubt. The point in dispute is, whether electricity can be transmitted through fluid bodies without decomposing them. In explaining and illustrating the subject, Professor Faraday introduced a number of experiments to show the relative powers of different substances in conducting frictional and voltaic electricity. The conduction of frictional electricity by wires, by the hand, and by a solid piece of nitre when applied to a charged electrometer, is supposed to be produced without any chemical action, and is called a "conduction proper;" but when liquids are the media through which electricity is conducted, decomposition takes place; and many experiments seem to confirm the opinion, which by some electricians is considered an established law, that the amount of decomposition has a definite relation to the quantity of electricity transmitted. It may be observed, that

Professor Faraday's researches have established the fact that when an electric current is passing through a fluid and decomposing it, the process of decomposition takes place instantaneously in each particle of the fluid that serves to conduct the electricity, and that a train of decompositions and recompositions is thus set in action. Whether any portion of electricity passes by "conduction proper," beyond that which thus decomposes the fluid, is the question that remains to be determined, and on which Professor Faraday expressed himself still doubtful, though it might be gathered from his observations, that his opinion leans towards the hypothesis of partial "conduction proper" through fluids. To give an idea of the vast quantities of electricity that are excited by chemical action, and the difficulty of estimating the amount transmitted, he kept a galvanometer deflected for a few moments by the excitement of electricity in a small pair of platinum and zinc plates applied to his tongue, and observed that in that short space of time a greater quantity of electricity had been called into action by those small plates than is contained in several thunder-storms. From this, it might be inferred that a quantity of voltaic electricity, inappreciable by the instruments employed in ordinary experiments, might be conducted unobserved without decomposing action, which quantity, however, if it had been in the state of intensity of frictional electricity, would exhibit powerful effects.

Professor Faraday noticed the experiments of electricians on the Continent, which appeared to confirm the notion that even frictional electricity cannot be conducted through water without decomposing it; and in opposition to that hypothesis he exhibited others, which he said it is difficult to explain, except on the supposition that water conducts directly, in the same manner as solid conductors. Two wet muslin bags, blown out, to resemble in effect two large soap bubbles, were held in the electric field, between the electrical machine and a conductor connected with the earth, without being so near as to receive any charge. When removed together, and applied to the electrometer, there was no indication of electricity; but when one bag was separated from the other whilst under the influence of electrical induction, they then exhibited electrical conditions, one being negative and the other positive, in the same manner as two metallic balls would. The evaporation of spirits of wine without decomposition, by the heat of two immersed conducting plates from a voltaic battery, was also noticed as evidence of "conduction proper" by a fluid. Professor Faraday, in conclusion, expressed his ignorance of the nature of the mysterious power of electricity, and said, with respect to the special action of the force he had that evening noticed, his mind was still in doubt.—*Atlas.*

TABLE-RAPPING.

SIR DAVID BREWSTER has communicated to the public journals an account of his sittings, whence we extract the following:—

"It is true that I saw at Cox's Hotel, in company with Lord Brougham, and at Ealing, in company with Mrs. Trollope, several mechanical effects which I was unable to explain. But though I could not account for all these effects, I

never thought of ascribing them to spirits stalking beneath the drapery of the table; and I saw enough to satisfy myself that they could all be produced by human hands and feet, and to prove to others that some of them, at least, had such an origin. Were Mr. Hume (the American medium) to assume the character of the Wizard of the West, I would enjoy his exhibition as much as that of other conjurors; but when he pretends to possess the power of introducing among the feet of his audience the spirits of the dead, of bringing them into physical communication with their dearest relatives, and of revealing the secrets of the grave, he insults religion and common sense, and tampers with the most sacred feelings of his victims." In another letter, Sir David enters in more detail into what Lord Brougham and he saw done by "the spirits," and what they did *not* see: "It is not true that the accordian *played an air throughout*, in Lord Brougham's hands. It merely squeaked. It is not true, as stated in an article referred to by Mr. Hume, that Lord Brougham's 'watch was taken out of his pocket, and found in the hands of some other person in the room.' No such experiment was tried. . . . At Mr. Cox's house, Mr. Hume, Mr. Cox, Lord Brougham, and myself sat down to a small table, Mr. Hume having previously requested us to examine if there was any machinery about his person, an examination, however, which we declined to make. When all our hands were upon the table noises were heard—rapping in abundance; and, finally, when we rose up the table actually rose, as appeared to me, from the ground. . . . Besides the experiments with the accordian, already mentioned, a small hand-bell, to be rung by the spirits, was placed on the ground, near my feet. I placed my feet round it in the form of an angle, to catch any intrusive apparatus. The bell did not ring; but when taken to a place near Mr. Hume's feet, it speedily came across and placed its handle in my hand. This was amusing. It did the same thing bunglingly to Lord Brougham, by knocking itself against his lordship's knuckles, and after a jingle it fell. The *séance* was most curious at Ealing, where I was a more watchful and a more successful observer. I will not repeat the revelations made to Mrs. Trollope, who was there, lest I should wound the feelings of one so accomplished and sensible. I remember them with unmingled pain. The spirits were here very active, prolific in raps of various intonations, making long tables heavy or light at command; tickling knees, male and female, but always on the side next the medium; tying knots in handkerchiefs drawn down from the table, and afterwards tossed upon it; and prompting Mr. Hume, when he had thrown himself into a trance, to a miserable paraphrase on the Lord's Prayer. During these experiments I made some observations worthy of notice. On one occasion the spirit gave a strong affirmative answer to a question by *three raps*, unusually loud. They proceeded from a part of the table exactly within the reach of Mr. Hume's foot, and I distinctly saw three movements in his loins, perfectly simultaneous with the three raps."

TABLE-TURNING AND SPIRIT-RAPPINGS.

We find the following in an able but brief notice of Faraday's *Experimental Researches in Electricity*, vol. iii., in the *Edinburgh New Philosophical Journal*, No. 3.

The hasty observers of whirling tables, and so-called spirit rappings, and all the host of half-trained amateurs who have imperfectly mastered the alphabet of electricity, should study a page or two of this volume, before intruding on the precious time of Faraday with ill-considered questions. He has been driven to make public complaint of the unreasonable demands thus made upon him, and that he is entitled to do so, those will most fully acknowledge, who can best follow the discussions of this profound book, and who also know how willing its author is to assist the studies of the unlearned, and how much he delights in rendering his attractive science a source of instruction and amusement even to children. Let those who decide upon the import of the most startling and unexpected physical phenomenon, after one or two hastily devised and imperfect experiments, read (to take one

example), the account of days, nay weeks, spent by our author in deciding the apparently simple, but in reality, very difficult question, "Can a Magnet exist with only a North or only a South Pole; or must it have two poles?" and till they have observed in the same spirit, and made certain that their supposed phenomenon has an actual existence, and that they have a distinct and *answerable* question to put, be slow to take such a man as Faraday from labours by which all his brethren are gainers.

PRESENT STATE OF ORGANIC ELECTRICITY.

PROFESSOR GOODSIR has communicated to the *Edinburgh New Philosophical Journal*, No. 4, "A Brief Review of the Present State of Organic Electricity."

The general Theory of Electricity, says the Professor, has rapidly approached a consistent form through the labours of recent physicists, and particularly by the researches of Mr. Faraday. The hypotheses of one or of two electric fluids, however modified, have been found tenable only so far as they involve the idea of force. In the phenomena of statical as in those of current electricity, there is constantly pressed upon the observer the necessity of admitting two forces, or two forms or directions of a force, inseparable from one another. And thus "the influence which is present in an electrical condition may best be conceived of as an axis of power having contrary forces, exactly equal in amount, in contrary directions."*

This peculiar form of force manifests itself in different kinds of inorganic matter, under circumstances such as friction, change of temperature, magnetic influence, and chemical action.

It is also manifested in organized beings, not only under circumstances in which they stand related to it as masses of mere matter, but more particularly during the actions performed by their component textures and organs.

Electrical science has been hitherto chiefly prosecuted in the region of inorganic nature; and although Volta opened up a boundless field of discovery in the region of inorganic under the influence of organic electricity, the latter still remains comparatively uncultivated.

In the investigation of electrical force, as manifested in organic nature, the peculiar economy of the organized being must be taken into account. Each organized being, although dependent on certain external circumstances as the conditions of its existence, is, nevertheless, a system *per se*. Irrespective of those electrical conditions into which it may be thrown, through surrounding bodies, or through the medium in which it lives, it undoubtedly contains more or less numerous sources of electrical disturbance, in the numerous processes and arrangements productive of currents, in the structures which collectively constitute its organization. The organized being may be considered *electrically* as a system of electrical currents, excited by electrical arrangements in the disposition of its fluids, textures, and organs.

So far as has yet been ascertained, these electrical currents, with

* Faraday, *Philosophical Transactions, and Experimental Researches in Electricity.*

the exception of those produced by the special batteries in the electrical fishes, are not employed in the economy of the being. They are merely necessary consequences of the organic processes carried on by the different structures; and effect, by their arrangement, the distribution of the resulting electricity, and the maintenance of the general electrical equilibrium of the organic system. The detection and investigation of these organic electrical phenomena are, however, important, not only for general electrical science, but also for the elucidation of the organic processes themselves. Residual phenomena, as such electrical disturbances must generally be considered in physiology, will, when investigated, indicate the probable nature of the actions from which they result.

Professor Goodsir then passes in review the electrical phenomena of plants, and their condition; and animal electricity, and the special electric apparatus in certain fishes.

FORCES EVOLVED DURING MUSCULAR CONTRACTION.

MR. H. F. BAXTER, in a paper contributed to the *Philosophical Magazine*, No. 65, thus concludes an Experimental Inquiry, undertaken with the view of ascertaining whether any Force is Evolved during Muscular Contraction analogous to the Force Evolved in the Gymnotus and the Torpedo; the communication having been previously read at the Royal Society:—

"The results of our inquiries lead us to believe that during muscular contraction a force *is* evolved, as in the fish, but that it is only during extraordinary muscular exertion that it can become manifest to the galvanometer. We are perfectly aware of the objections that may be urged in reference to the fish being provided with a special apparatus. In our first endeavours also to obtain some result with the galvanometer, and in which we failed to obtain any evidence of the existence of a force being evolved, we were then led to the conclusion as to the improbability of any force becoming free, as it were, during muscular contraction; that whatever force might be present would be expended or converted during the act of contraction; but we could never get over the difficulty which the results of Matteucci, obtained by means of the frog, presented for our consideration, and which is doubly increased by the results we have now related in the present paper. In reference to the fish, also, we must remember that the force evolved bears some relation, according to Matteucci, 'to the activity of the functions of circulation and of respiration, and of every act of nutrition.' The apparatus may be a *means* for the evolution of the force, but not a *producer* of the force; and we have some reasons for believing that the electric condition of the blood in the living animal must not be overlooked."

NEW SPECIES OF ELECTRIC FISH.

MR. ANDREW MURRAY, in a paper communicated by him to the *Edinburgh New Philosophical Journal*, No. 3, "On the Natural History of Electric Fishes," describes a new species of *Malapterurus*, found near Creek Town, in the muddy, brackish water of the river Old Calabar. Mr. Murray has received four specimens of this undescribed

species of *Malapterurus.* None of them exceeded four inches in length, although the Rev. Mr. Waddell (a resident missionary, from whom Mr. Murray received the fish), mentions that they grow to be as large as a herring. They seem to have been powerfully endowed with the electric faculty; in this respect differing from the Nile species, which has its electrical power weak in comparison with that of the *Gymnotus;* while this new species would appear to surpass it in force (particularly when size is taken into consideration), a small specimen about two inches in length having given Mr. Waddell a shock which reached to his shoulder. They seem to bear captivity well, for Mr. Waddell kept one of them for six weeks in a tumbler of water, and it gave severe shocks daily.

Mr. Murray gives the description of this species, to which he adds: "It will be seen that the principal differences between the *Malapterurus electricus* and this species are the following. The former is a larger fish, reaching fourteen, and even twenty-one inches in length, while the ordinary dimensions of this would appear to be about four inches, although it may sometimes reach six or eight. The formula of the number of rays in the fins of the two fishes also differ. The number in the ventrals and caudal are the same, but the Nile fish has nine in the pectoral and twelve in the anal, while in this fish there are respectively only eight and eight. In the *M. electricus* the upper jaw slightly projects over the under. In this species the reverse is the case, the lower jaw projecting decidedly (though not very far) in advance of the upper. The barbule on the upper jaw of *M. electricus* is a third shorter than the head; *Beninensis* (the name given to this new species, from the river emptying itself into the Bight of Benin) has it longer than the head. In the former the gill-opening terminates at the lower edge of the pectoral fin, in the latter the pectoral fin is attached at the middle of the gill-opening, and its lower edge does not nearly reach the base of the gill-opening. There are some differences in the relative proportion of the different parts of the two fishes, and there are also some other differences in the form of some parts of the fishes (such as the operculum), which are not so readily embodied in words, but the differences which will most easily enable them to be distinguished at a glance are the markings, if these shall be found to be constant. The spots on *M. electricus* are much larger and more numerous than on this species, and it entirely wants the white bands across the tail, and across the caudal fin, which have been above described.

In the subsequent Number of the journal, Mr. Murray adds the following interesting information received from Mr. W. C. Thomson, who was stationed for several years at the Creek Town mission station on the river Old Calabar.

Mr. Thomson states that the electric properties of the fish are made use of by the natives as a cure for their sick children. The fish is put into a dish containing water, and the child made to play with it; or the child is put in a tub or other vessel with water, and one or more of the fish put in beside it. It is interesting to find that a remedy, which has only of recent years come into favour among ourselves, should have been already anticipated by the unlettered savage, who probably has

had the remedy handed down to him by tradition from remote generations.

Mr. Thomson also mentions an instance of the electric power which fell under his own notice. He had a tame heron which had been taken young, and never had had an opportunity of fishing for itself. On one occasion, some live fish were brought for it, and among them was a small *Malapterurus.* The bird swallowed it, but had no sooner done so than it gave a great scream, and was thrown violently backwards. It got up again, and soon recovered, but always remembered the circumstance, and would never after touch a *Malapterurus.*

Professor Goodsir, in a paper read by him to the Royal Physical Society, after reviewing shortly the results of Pacini's recent examination of the electrical organs of *Torpedo*, *Gymnotus*, and *Malapterurus*, and his own examination of the presumed electrical organ in the tail of the skate, discovered by Dr. Stark, and subsequently described by Robin, states that, so far as his own dissection had proceeded, the structure of the specimen of *Malapterurus*, for which he was indebted to Mr. Murray, corresponded with the description of Pacini; with the exception of the structure of the electrical organs themselves, in which he had hitherto failed in detecting lozenge-shaped plates or cerebral cells, but could make out only a fibrous meshwork, permeated by a gelatinous granular substance, as had been previously stated by M. Geoffrey St. Hilaire. The presumed inner electrical organs he found, as Pacini had described, to be merely fibrous membranes, with subjacent fatty deposits.

VOLTAIC ELECTRICITY.

Dr. Tyndall, in a lecture delivered by him at the Royal Institution, has noticed the peculiar developments of the force by Secondary Currents and by Heat. When an electric current passes through a coil of copper wire, it induces an action in bodies around the coil. Thus, when a piece of soft iron is introduced within the hollow formed by the twisted wire, it becomes strongly magnetic, and magnetism is also induced in iron brought near any part of a wire through which voltaic electricity is transmitted. If, instead of iron, the coil is surrounded with another coil of thinner copper wire, the latter becomes charged with electricity at the moment of making and breaking contact with the voltaic battery, though no portion of the electricity from the battery passes directly through it. The effects of the secondary currents thus induced were shown by several experiments, in which the momentary action on the galvanometer was illustrated by a wire in no manner connected directly with the voltaic battery. One of these experiments exhibited this remarkable action in a striking and novel manner, exemplifying at the same time the close connexion between electricity and magnetism. A large hollow coil was placed vertically on the lecture table, and whilst the ends of the wire were connected with the voltaic battery, iron nails were dropped into the centre. The instantaneous induction of magnetism in the nails as they fell through the hollow coil, excited electricity in the secondary coil, which developed itself by deflecting the needle of a galvanometer. The effect of heat in developing electricity, which was first made known by Professor Seesbeck, was

explained and illustrated in a variety of experiments. To produce the effect it is necessary that there should be a variation of temperature; and it would appear indeed, that all variations of temperature, in metals at least, excite electricity. When the wires of a galvanometer were brought in contact with the two ends of a heated poker, the prompt deflection of the galvanometer needle indicated that a current of electricity had been sent through the instrument. Even the two ends of a spoon, one of which had been dipped in hot water, served to develop an electric current; and in cutting a hot beef-steak with a steel knife and a silver fork there was an excitement of electricity. The two metals that exhibit the phenomenon most sensitively are bismuth and antimony when soldered together, and heated at the point of junction. The mere heat of the finger was shown to be sufficient to cause the deflection of the galvanometer; and when ice was applied to the part that had been previously warmed, the galvanometer needle was deflected in the contrary direction. By an alternating series of small bismuth and antimony bars, the effect may be increased in the same manner as the effect of a voltaic battery is intensified by adding to the number of plates. A small instrument invented by Melloni was exhibited, which was so extremely sensitive of the action of heat, that electricity was excited when the hand was held six inches from it. It is not necessary, however, that different metals should be used to produce sensitive effects; for a length of brass wire annealed at given distances may be made to develop electricity very readily if all the points which have been annealed are doubled together and then warmed by the hand. When a thermo-electric wire is heated below redness, the electric current developed is in the opposite direction to the current excited when the temperature is increased to incandescence. This remarkable fact was illustrated by holding the wire in a spirit-lamp, when the needle of the galvanometer, which had been first deflected in one direction, turned in the opposite direction as soon as the wire became red hot. Dr. Tyndall said that no satisfactory explanation had been discovered for this very curious phenomenon.

ELECTRIC FORCE.

Dr. Tyndall, in a lecture delivered by him at the Royal Institution, has entered into the consideration of the Phenomena of Electricity, and illustrated, by a variety of experiments, some of the peculiar actions of Electric Force. The attraction of light bodies to an excited electric was shown to be not limited to the friction of glass and resinous substances, but that numerous others, such as calcareous spar, sulphur, and paper, become electrical when rubbed with silk or flannel. The effect of simple attraction was first shown, and then the phenomena of repulsion between bodies that had been excited with the same kind of electricity. This repulsion of bodies in the same electrical state was exhibited in a remarkable manner in excited paper. A sheet of foolscap placed on a dry board was rubbed over with Indiarubber, which caused the paper to adhere closely to the wood, and strips of the paper being then cut off with a knife they strongly repelled each other. Dr. Tyndall said the hypothesis assumed for the purpose of conveying

an idea of the excitement of electricity is, that the friction of an electric machine produces, in some unknown manner, a thin stratum of electric fluid to diffuse itself over the surface; and that electricity of the same kind exerts a repulsive force against its own particles, whilst it attracts other bodies not in the same condition. He then showed by several experiments that there are two kinds of electricity, commonly called vitreous and resinous, or positive and negative, and that they mutually attract each other. The excitement of negative electricity by the friction of sealing-wax, shell-lac, and other substances, and its attractive action on bodies to which electricity from an excited glass tube had been communicated, occupied a considerable portion of the lecture, the indicators employed being in most instances glass rods balanced upon points. To exhibit how readily electricity is excited during ordinary operations, Dr. Tyndall caused the gold leaves of the electroscope to diverge by striking on the back of his assistant, when standing on a glass stool, with a prepared cat's skin. It is frequently of great importance in electrical investigations to determine whether the electricity developed is positive or negative, for which purpose an instrument, called the electric syringe, has been contrived, the action of which was explained; but the somewhat complicated apparatus does not answer the purpose more effectively than a stick of common sealing-wax. Dr. Tyndall showed also by several experiments that the rubber with which an electric is excited becomes at the same time electrical, so that it is difficult to distinguish the rubber from the electric, as the action seems to be mutual. He had some difficulty in exhibiting the electricity of the silk rubber, though it was distinctly manifest in flannel; the amalgam in the former having, no doubt, served to conduct the electricity to the hand.

THE ELECTRIC SPARK.

Dr. Tyndall, in the ninth lecture of his course on Magnetism and Electricity at the Royal Institution, made the chief point of interest the nature of the Electric Spark, which he undertook to examine. He prefaced his observations on the subject by noticing the difficulty which all original investigators experience from having to overcome the preconceived notions of popular hypotheses, and the erroneous views which the terms often given to phenomena convey. Thus the word "fluid," as applied to electricity, though it seems to convey a generally correct idea of the action of the force excited, is calculated to mislead investigators into the nature of the force itself, as there is no proof that it partakes of the character of fluid bodies. Dr. Tyndall attributes the light of the electric spark not to the appearance of electricity itself, but to the incandescence of particles of matter interposed in the interval in which the disruptive discharge of an electrified body takes place. He noticed the peculiar action of electric sparks in converting oxygen gas into ozone; and as ozone is by some chemists considered to be a modification of oxygen, by which its active powers are greatly exalted, Dr. Tyndall seemed inclined to believe that the matter of the electric spark would be found to be that peculiar state of oxygen; though he said he had not yet made sufficient experiment on the subject to enable him

to arrive at a definite opinion. He then explained the phenomena of the Leyden jar, commencing with the exhibition of a similar electrical condition in plates of glass, which had metallic plates on both sides. Thus, when positive electricity is communicated to the metallic plate on one side of the glass, the negative electricity is attracted to the plate on the other side, and the positive electricity is repelled to the earth. In that condition, the glass, with its metallic coatings, may be highly charged; though, being neutralized, it does not part with its electricity to surrounding bodies until a communication is made between the two coatings. In the same manner the action of the condenser was explained. The two metal plates, when brought near to each other, and one of them is feebly charged, give no indication of electricity, because the positive and the negative electricities of the two plates are neutralised. But when one of the plates is removed, the electricity on the other becomes directly manifest; and in this manner the feeblest traces of electricity may be indicated. The phenomena of the electrophorus were also explained on the hypothesis of the separation of two distinct electricities by their mutual attractions and repulsions. The slab of wax, when excited by fire, becomes negative; and when an insulated metal disc is placed upon it, the positive electricity in the metal is supposed to be attracted to the side nearest the wax, and the negative electricity to be repelled to the top. On allowing the negative electricity of the disc to escape, by touching it, the disc remains positively electrified. Dr. Tyndall concluded by exhibiting some of the powerful effects of electricity, by means of a battery consisting of fifteen large jars, with which fine wires of different metals were deflagrated and dissipated into powder.

POSITION OF ALUMINUM IN THE VOLTAIC SERIES.

HAVING, through the kindness of Dr. Hofmann, been permitted to examine a specimen of aluminum prepared by M. Claire-Deville, (says Professor Wheatstone,) I availed myself of the opportunity to ascertain one of the physical properties of this extraordinary metal, which it does not appear has been yet determined, viz., its order in the voltaic series. The following are the results of my experiments.

Solution of potass acts more energetically and with a greater evolution of hydrogen gas upon aluminum than it does on zinc, cadmium, or tin. In this liquid aluminum is negative to zinc, and positive to cadmium, tin, lead, iron, copper, and platina. Employed as the positive metal, the most steady and energetic current is obtained when it is opposed to copper as the negative metal; all the other metals negative to it which were tried became rapidly polarized, whether above or below copper in the series.

In a solution of hydrochloric acid, aluminum is negative to zinc and cadmium, and positive to all the other metals above named. With this liquid also, copper opposed to it as the negative metal, gave the strongest and most constant current.

Nitric and sulphuric acids are known not to act chemically in any sensible manner on aluminum. With the former acid diluted as the

exciting liquid, aluminum is negative to zinc, cadmium, tin, lead, and iron. The current with zinc is strong; with the other metals very weak, and it is probable that their apparent negative condition is the result of polarization. When aluminum is immersed in dilute sulphuric acid, this metal appears negative to zinc, cadmium, tin, and iron, but with lead, on which sulphuric acid has no action, the current is insensible. In both these liquids copper and platina are negative to aluminum, and notwithstanding the apparent absence of chemical action on the latter metal, weak currents are produced.

It is rather remarkable, that a metal, the atomic number of which is so small, and the specific gravity of which is so low, should occupy such a position in the electromotive scale as to be more negative than zinc in the series.—*Proceedings of the Royal Society.*

FLUID GALVANIC BATTERY.

THE Rev. Professor Callan states:—"I have lately tried a battery of 70 4-inch cells, in which the zinc and cast iron were very near to each other. The battery was charged with one part of sulphuric acid and three of a solution of common salt. The experiments consisted in the ignition of metals and coke-points. A brass wire $\frac{1}{4}$ of an inch diameter, and a piece of zinc about $\frac{3}{8}$ by $\frac{1}{4}$ of an inch thick, were burnt away so rapidly that the lecture room, which is about 40 feet square and 18 high, was soon filled with the smoke produced by the combustion of the metals.

"For the coke light, I used Deleuil's apparatus; the light was sufficiently intense to enable a person to read the smallest print at the most distant part of the room whilst the window-shutters were closed. During the entire time of the experiments, which lasted nearly an hour and a half, the action of the battery was not suspended for more than about five minutes. At the end of the experiments, the light appeared to be as brilliant as at the commencement. Had there been time to continue the experiments, the power of the battery would, I think, have been sufficient to produce a strong coke light for another hour or half-hour. The cost of the acid used in charging the 70 cells was about 9*d.* or 10*d.*

"The voltaic current by which the metals and coke-points were ignited was constantly passing through the coil of the galvanometer. I forgot to observe the deflection produced by the voltaic current during the combustion of the metals; but during the ignition of the coke-points, the deflection was frequently observed: the average deflection did not exceed 40°. I have since found that the current from a single pair of plates, each an inch and a half square, produces a deflection of 58°, which requires a current about twice as powerful as one which would cause a deflection of 40°. Hence not more than about the $\frac{1}{16}$th of the power of the 70 4-inch cells was employed in producing the coke light. Fifteen-sixteenths of their power was inactive, whilst the exciting fluid was acting on the metals, and wasting its own strength. Hence it strikes me, that for the electric light which is now used for practical purposes, a battery consisting of 80 or 90 cells, each about an inch and

a half or two inches square, would be the most economical. I purpose to get a battery of 100 pairs of plates, each two inches or an inch and a half square, in order to try its power of producing the electric light.

"The greatest length of the flame between the coke-points appeared to me to be less than it would be with a nitric acid battery of 70 4-inch cells. Hence I infer that the intensity of the single fluid battery is less than that of the nitric acid battery, although the quantity of electricity is much greater. The state of some of the cells after the experiments excited an apprehension that the distance of $\frac{1}{16}$th of an inch between the zinc and iron may not be sufficient for the free descent of the sulphate of zinc, though it may permit the hydrogen to escape with perfect freedom. However, I am inclined to ascribe the condition of the cells, which were new, to the sand which remained attached to them after they were taken out of the mould."—*Philosophical Magazine*, No. 59.

EXPERIMENTS WITH ELECTRIC AND OTHER LIGHTS.

EXPERIMENTS have been made on the upper part of the Common at Woolwich, in the presence of a Select Committee, when three different kinds of Lights, for War and other purposes, were tested. The first was the Electric Light, which was exhibited by Mr. Inglis; the second the Drummond Light, exhibited by Sergeant R. P. Jones, of the Royal Sappers and Miners; and the third the Bude Light, of Mr. Gurney, who also entrusted it to the care of Sergeant Jones. The Electric Light is reported to have appeared to possess the power of penetrating farthest into darkness, and was the most brilliant; but the Drummond also possessed some advantages. It was more portable, and could be carried by two or three men, each taking a portion of the apparatus, whereas the electric light required a waggon drawn by two horses to convey it from place to place.

THE ELECTRIC CLOCK AT THE SOUTH-EASTERN RAILWAY TERMINUS, LONDON BRIDGE.

ON the 1st of November, 1852, the system of sending time signals hour by hour from the Royal Observatory at Greenwich to various telegraph stations came into successful operation. Certain hour signals were required by the South-Eastern Railway Company, and the remainder were passed on to the Electric Telegraph Company for distribution along their system. The interchanges of connexions for these purposes were accomplished by a commutator carried by the great clock at the London terminus. The next step in the system was to show time to shipping in the Downs by the drop of a ball at Deal, caused by a telegraph signal sent from the Greenwich clock at 1 P.M. For the successful carrying out of this it was deemed prudent to erect a clock in London for the special purpose of carrying the commutator. Mr. C. V. Walker, the telegraph engineer to the South-Eastern Company, had found by experiment that the pendulum at Greenwich would keep one of Shepherd's electric clocks going on the lecture-table of the London Institution, and he proposed to the Astronomer Royal that the commutator should be carried at London by one of these clocks. On the 3rd of March last one clock was erected over the North-Kent platform, facing

passengers as they arrive in London; and since that date it has faithfully shown Greenwich time, which is sent to it, second by second, from the Royal Observatory. The clock is the property of the Government, and is under the charge of Mr. Airy on the part of the Admiralty, and of Mr. Walker on the part of the South-Eastern Company, under whose joint care the clock, with the adjuncts essential for the purposes in question, was constructed. In the common state of things, the commutator is out of gear, and the hour signal wire is continuous from Greenwich to the Electric Telegraph Company's system; but on the approach of any of the hours when the signal is required on the South-Eastern lines, the ball-drop signal, for instance, the commutator will have arrived at such a position that at about one minute before the hour the Greenwich and the Deal wires will have been lifted from their normal positions, and held together until nearly a minute after the signal shall have passed; when the ball at Deal is nearly down the mast, viz., in about 15 seconds, it returns a signal to Greenwich in proof that it has dropped. The drop is produced with the utmost regularity, a failure being extremely rare. Commutators are carried by local electric clocks at Ashford and Deal, and the adjustments there and elsewhere are such, that the connexions are made without extraneous aid, and it is out of the power of the instrument clerks, through inadvertence, themselves to send a signal and cause a false drop. Within the London clock are galvanometers, which show the hourly signals that come from Greenwich on distinct wires, and afford a means of observing that the clock is showing true time; by another process the time shown by the clock is read off at 8 A.M. daily at Tunbridge, and its accuracy tested. This clock promises to be the basis of operations, as the system becomes developed, of distributing time to the great public buildings of the metropolis.

EXPERIMENTS MADE WITH THE SUBMARINE CABLE OF THE MEDITERRANEAN ELECTRIC TELEGRAPH.

THE following results were obtained by Professor Wheatstone between May 24 and June 8 in last year, with the Telegraphic Cable manufactured by Messrs. Kuper and Co., of East Greenwich, for the purpose of being laid across the Mediterranean Sea, from Spezia, on the coast of Italy, to the Island of Corsica.

The cable was 110 miles in length, and contained six copper wires, one-sixteenth of an inch in diameter, each separately insulated in a covering of gutta-percha one-tenth of an inch in thickness. The whole was surrounded by twelve thick iron wires twisted spirally around it, forming a complete metallic envelope one-third of an inch in thickness. A section of the cable presented the six wires arranged in a circle of half an inch diameter, and one-fifth of an inch from the internal surface of the iron envelope.

The cable was coiled in a dry well in the yard, and one of its ends was brought into the manufactory. The wires were numbered 1, 2, 3, 4, 5, 6, and the ends in the well were indicated by an accent; the ends 1′2, 2′3, 3′4, 4′5, 5′6, were connected by supplementary wires, so that the electric current might be passed in the same direction through

all the six wires joined to a single length, or through any lesser number of them, the connexions being made at pleasure in the experimenting room.

The rheomotor employed was an insulated voltaic battery consisting of twelve troughs, each of twelve elements, which had been several weeks in action.

From certain of these experiments it seems to result, that whatever length of wire is connected with the battery, if a galvanometer is placed at the farther extremity of the wire and a constant length added to the other termination of the galvanometer, its indication remains always nearly the same. Thus the galvanometer indicated $6\frac{1}{2}°$ when it was placed close to the battery and 110 miles of wire were subjoined beyond it; and 5° when 550 miles were interposed between the battery and galvanometer, the same length, 110 miles, being subjoined. In like manner, when 220 miles were added beyond the galvanometer placed near the battery, the indication was 12°; precisely the same as when 440 miles were interposed and 220 added. So also when 330 miles were added, the deviation of the galvanometer was 18°; and 15° when 330 miles were interposed and 330 added. I have no doubt that the correspondence would have been closer had it not been for the fluctuations of the battery.

It would appear from this, that whatever be the length of wire attached to the insulated pole of a battery, it becomes charged to the same degree of tension throughout its entire extent; so that another insulated wire brought into connexion with its free extremity exhibits precisely the same phenomena, in kind and measure, as when it is brought into immediate connexion with a pole of the battery. Some important practical consequences flow from this conclusion.—*Proceedings of the Royal Society.*

TELEGRAPH OF A RUNNING TRAIN.

DR. TYNDALL, in a lecture on Voltaic Electricity, delivered by him at the Royal Institution, after explaining the principle and the elementary construction of Professor Wheatstone's original needle and alphabetic dial telegraph, proceeded to describe one of the most recent applications of voltaic electricity to telegraph purposes in the indication of the progress of railway trains. One of the instruments, and a large model of a railway to illustrate its action, was in front of the lecture table. The instrument consists of a dial, with a hand that moves round with step-by-step action, each movement being under the control of an electro-magnet, that holds a detent. When the electro-magnet ceases to act, the detent is released, and the hand moves forward a step, and these steps are indicated by marks on the dial like the divisions on a clock face. To apply the instrument to indicate the position of a railway train, an insulated wire must be laid down along the rail, through which a voltaic current must be constantly maintained during the running of the trains. At certain fixed intervals, at equal distances, whether of miles or half-miles, the wire is brought within the range of action of a passing train, and by a projecting arm, or other arrangement, a spring is pressed down, which breaks the electric

circuit. The instant the voltaic current is thus interrupted the electro-magnet of the instrument ceases to act, the detent is withdrawn, and the hand on the dial makes one step in advance. If instruments so arranged were placed at each station, they would thus indicate the progress of a train, or whether any accident had occurred to detain it, and the spot where the accident had occurred. The utility of an apparatus of this kind, especially on all single lines of rail, would be very great, and Dr. Tyndall expressed the opinion that it is quite practicable to apply it. Its action, however, must apparently be limited to short distances, for when several trains are following each other on the same line it would require some further special arrangement to make separate indications by means of the same wire.

DESPATCHES BY THE ELECTRIC TELEGRAPH.

DR. LARDNER, in a letter to the *Times*, dated Paris, September 22, records the following fact,—to show that the despatches detailing the Fall of Sebastopol might have been sent (supposing them to fill six columns of the *Times*) to London in two hours, by means which were no secret, and were at the disposition of the Government; whereas the public were kept waiting for the details about a fortnight.

"Some time since, the following experiment was made under the direction of M. Leverrier and myself at the Ministry of the Interior, in the presence of two commissions—one of the Legislative Assembly, and the other of the Institute:—A telegraphic wire was prepared which extended over a great part of France, its two extremities being brought into the room where the experiment was made. The length of the wire was 1082 miles. The arrival as well as the departure of the despatch took place under the eyes of the commissions. A despatch consisting of 282 words was transmitted from one end of the wire. A style attached to the other end immediately began to write the message on a sheet of paper. The entire message was written in full, each word being spelled completely, and without abridgment, in *fifty-two seconds*.

"By this means, therefore, 20,000 words, using round numbers, would be transmitted in an hour; six columns of such correspondence as you publish would be transmitted *in two hours*.

"It is scarcely necessary to say that neither the length of the despatch nor the distance has anything to do with the result. The promptitude of the arrival would for all practical purposes be as great for 10,000 as for 1000 miles, and the length of the despatch would merely augment the time of its delivery in the ratio of about 300 words per minute.

"Why, then, do not the Governments of England and France avail themselves of this power? After the above experiment, the French Government had the necessary apparatus constructed, and still possesses it. I have more than once asked the authorities why they did not avail themselves of it. Their answer was, that, save in the most rare and exceptional cases, twenty or thirty words were quite sufficient for telegraphic messages, and that it was not worth while to organize a staff to work the telegraph in these exceptional cases.

"The power to transmit the long despatches, you will see, was not disputed.

"I may add that, with the concurrence of the intermediate States through which the wires are carried, means are practicable and easy by which the contents of the despatches transmitted would be unknown to all but the persons at the terminal stations.

"I ought perhaps to add that, being neither inventor nor shareholder, in telegraphic enterprises, I have no other interest in this matter except that which is common to the public."

FARADAY AND THE ELECTRIC TELEGRAPH.

"The mention of the Telegraph," says an able reviewer of Faraday's *Experimental Researches in Electricity*, "reminds us of the application of the author's own discovery to telegraphic purposes, whereby the grave difficulties presented to the transmission of ordinary voltaic electricity through subterranean wires are practically overcome. The public never hear Faraday's name mentioned in connexion with the electric telegraph—scarcely that of Volta; the public contemplate the flower, but see not the roots from which its petals are fed; the men who have given the telegraph its present practical form are deserving of public esteem, and have obtained both it and more substantial marks of public appreciation; and yet the merits of Faraday, in comparison with such men, are about in the ratio of Prometheus to Dr. Kahn. Down deep in the mysteries of Nature, he and his great *confrère* Volta found the forces which pulse through the telegraphic wire. Honour to those who by their mechanical skill have brought these great discoveries home to human hearths, and made them the ministers of society; but a higher and nobler meed be his who brought us the fire from heaven which imparts life and activity to the telegraphic mechanism. This is the position of Faraday, this the position of Volta, although neither of them even derive the poor breath of popular applause in return for their transcendent services."—*Philosophical Magazine.*

IMPORTANT IMPROVEMENT IN THE ELECTRIC TELEGRAPH.

A discovery is stated to have been recently made at Stockholm, which, if it can be realized and practically applied, will tend greatly to facilitate telegraphic communications. The discovery to which we allude is the means of transmitting two messages at the same time along a single wire.

It is evident that if at the same instant a message is sent along a wire in one direction, another message could be speeding its way through the same wire in the opposite course, one-half the number of wires would be sufficient, and there would consequently be a great saving in the cost of forming new telegraph lines, and that those already laid down would be enabled to transact double the amount of business they are now capable of doing. To those who are not acquainted with the mode of transmitting electric telegraph signals, it may appear at first sight impossible to send messages in opposite directions at the same time along a single wire, as one current of electricity, it might be supposed, must necessarily clash with and counteract the transmission of another current in the opposite direction. But, in point of fact, not two only, but hundreds of electric currents in different directions are frequently passing through the same medium, without the slightest

interference. The difficulty to be overcome is altogether of a practical kind, and that it does not arise from any limited capacity in the wire may be shown by actual practice in existing telegraphs.

In the early days of the electric telegraph, before the conducting power of the earth was well known, a single wire only was employed for the return current, though several were required to transmit messages, and through that single wire different currents were often passing at the same instant. When the conducting power of the earth was applied to complete one-half the circuit, the moist ground became the transmitter of currents from every electric telegraph that was established, and through that medium there are now passing messages of all kinds, which, though mingled together in mother earth, become separated at the poles of their respective voltaic batteries, and are delivered without any interference with one another. Thus in constructing a telegraphic line, a wire insulated from connexion with the ground, by being supported on posts, is extended between the towns to be placed in communication, and at each end the wire is connected with a copper plate buried in the earth, to complete the voltaic circuit. These plates of copper, technically called "earth plates," or more commonly "earths," conduct the electricity from one to the other through the moisture of the earth much more readily than any artificial metallic conductors that could be laid down; the resistance thus offered to the transmission of electricity being so small as to be scarcely appreciable. These earth connexions are so convenient that they have been formed at all the stations where telegraphs have been established, which are thus voltaically connected together. Suppose, for instance, that the zinc end of a voltaic battery is connected with the earth, and that the copper end is connected with a needle instrument in London, and that that is connected with the telegraph wire supported on posts and extended to Edinburgh, where, after passing through a corresponding instrument, it is connected with a metal plate buried in the ground. The electric current will then pass through the instrument in London, along the wire to Edinburgh, where it will deflect the needle, and passing on to "earth," will there come into instantaneous connexion with the zinc end of the battery from which the current emanated, and will return to that battery regardless of all interposing electric currents that may be passing through the earth at the same time. A slight knowledge of the nature of a voltaic battery will be sufficient to prove that it could not be otherwise. No excitement of voltaic electricity can take place unless there be a connexion between the two poles of the battery. So long, therefore, as the wire at Edinburgh continues detached from the earth plate, the battery in London remains inactive, provided the wire be perfectly insulated. It is by the act of bringing the two poles into connexion by means of the wire and earth plate at Edinburgh that the electricity is excited, and the current is sent in that direction alone. The action of all other batteries that may be connected with the earth cannot affect the electric current thus established between London and Edinburgh, because they do not contribute in any way to complete the circuit by which alone the electricity is at once excited and transmitted. A metallic con-

ductor, in the same manner, will connect the opposite poles of any number of batteries, and will thus serve to transmit several differing electric currents without their interfering. It would not be difficult, indeed, to make a single wire form part of the circuits of one hundred different batteries, each one of which might be transmitting distinct telegraphic messages.

From this consideration of the facility with which a single wire can conduct different electric currents, it might be supposed that there would be no difficulty in completing such an arrangement as is now said to have been effected in Sweden, and that one wire might be made to serve the purpose of the thirteen that are supported on posts near London, in addition to others that are buried underground. It is, nevertheless, one of those things which, though often attempted, has not yet been practically accomplished; nor do the accounts of the discovery by Professor E. Edlund, of Stockholm, represent him to have done more than send two currents along the same wire, and those in opposite directions. The great difficulty to be overcome in endeavouring to effect such an arrangement is, to prevent the electric current from the transmitting battery from making a short circuit through the adjoining instrument, instead of traversing the wire to the corresponding instrument at the distant station.

We quote the above from the *Civil Engineer and Architects' Journal*, wherein an ingenious suggestion is made for overcoming the difficulty.

ATMOSPHERIC ELECTRICITY.

A PAPER has been read to the British Association, "On the Detection and Measurement of Atmospheric Electricity by the Photo-Barograph and Thermograph," by Mr. M. J. Johnson. Photography has already rendered considerable aid to science, and some results brought before the Section by Mr. Johnson, Radcliffe Observer, Oxford, furnish an example of this. On examining and comparing the registrations of the thermometer and barometer certain peculiarities presented themselves, which indicate a curious connexion between the course of these instruments and the state of the weather. The line which indicates this course is sometimes serrated, sometimes even and continuous; and these appearances correspond to certain determinate states of the weather. The most remarkable result is a sudden change of the height of the barometric column, which takes place simultaneously with the occurrence of a peal of thunder:—a contemporaneous effect was produced upon the thermometer. It is to be hoped that Mr. Johnson will continue his observations, so as to place the connexion, which he seems to have detected, beyond all doubt.

SUBMARINE TELEGRAPH CABLES.

THE late failures in the laying of the Submarine Telegraph Cables, in the Gulf of St. Lawrence and the Mediterranean Sea, have not surprised us, knowing, as we do, the principle upon which they are constructed, and their probable insufficiency to maintain the integrity of the copper conducting wires. In the laying of such cables, the risks of fracture are greater as the weights, and the depths to which the cables

are laid increase. They are formed, as our readers may know, by winding several iron wires spirally round a core composed of the insulated conducting wires and hemp yarn. Now when an increased strain (resulting from an increase in the depth of the water) is exerted upon such a cable, there is danger of the external spiral wires yielding to the tension, and thus collapsing and pressing unduly upon the core; and if this action takes place, the copper wires are likely to be completely sundered, while the outer spiral wires remain entire, and the cable is as a whole as strong as ever. The powerful breaks used in the paying out of these cables tend to increase the risks of straining them. This appears to be what has just occurred in the Gulf of St. Lawrence and the Mediterranean, from the effects of rough weather, great depths, and excessive weights—in the last instance, eight tons to the mile. The failure in these cases were brought before the public with more than ordinary prominence by the indiscreet heralding by which the undertakings were preceded; and we advert to the subject lest a general impression that the difficulties to be encountered were insurmountable, should be acquired.

Mr. T. Allan has patented a submarine rope, in which the crushing and stretching effects above described could not possibly occur. As these ropes are proportionally both lighter and cheaper than the others, weighing, with the conducting wires, only about three tons to a mile, we are surprised that they have not yet been adopted. Such ropes might, of course, be broken under some circumstances, but, unlike the others, they would never be rendered useless until the whole strength of the rope fairly gave way.

The principle upon which this rope is constructed is that of having an incompressible and inextensible core, by which arrangement all rending or crushing forces are prevented from acting upon the insulated wires, and the security of the rope is made very great.—*Mechanics' Magazine*, No. 1682.

LAYING ELECTRICAL CONDUCTORS.

MESSRS. W. J. MACQUORN RANKINE, C.E., and Mr. John Thomson, (of the East Indian Railway,) have patented a method of Laying Electrical Conductors, for submarine telegraph communication. The resistance of fluids is employed under this patent; such fluids being forced by pumps through adjustable valves to regulate the speed of the drums and pulleys by which the cable is dropped. The inventors calculate on thus saving the labour of twenty or thirty men, enabling *one man* to regulate the speed of the cable by opening and closing a valve; rendering the whole operation, in great depths of water, incomparably safer, more certain, and more expeditious, as well as cheaper, than it is at present.

EXPERIMENTAL OBSERVATIONS ON SUBMARINE ELECTRIC CABLES.

MR. WILDMAN WHITEHOUSE has read to the British Association a paper, in which, after referring to the rapid progress in submarine telegraphy which the last four years have witnessed, Mr. Whitehouse said that he regarded it as an established fact that the nautical and engineering difficulties which at first existed had been already over-

come, and that the experience gained in submerging the shorter lengths had enabled the projectors to provide for all contingencies affecting the greater. The author then drew attention to a series of experimental observations which he had recently made upon the Mediterranean and Newfoundland cables, before they sailed for their respective destinations. These cables contained an aggregate of 1115 miles of insulated electric wire, and the experiments were conducted chiefly with reference to the problem of the practicability of establishing electric communications with India, Australia, and America. The results of all the experiments were recorded by a steel style upon electro-chemical paper by the action of the current itself, while the paper was at the same time divided into seconds and fractional parts of a second, by the use of a pendulum. This mode of operating admits of great delicacy in the determination of the results, as the seconds can afterwards be divided into hundredths by the use of a "vernier," and the result read off with the same facility as a barometric observation. Enlarged fac-similes of the electric autographs, as the author calls them, were exhibited as diagrams and the actual slips of the "handwriting" of the current.

The result of a great number of observations (more than 5000), collected, and carefully measured, to ascertain the velocity of the current, shows from one-twelfth to one-sixteenth of a second as the time occupied in the 300 miles circuit; one-sixth to one-ninth of a second for 600 miles; and one-fourth to one-fifth for 900 miles; giving a velocity varying from 3600 to 4500 miles in the second. When we compare these results with those previously obtained by autograph of the voltaic current, we are startled at the discrepancy; from a minimum of 1000 or 1100 miles in the second, to a mean average of not less than 4000 miles, and yet both are equally truthful, and were obtained with equal care. Mr. Whitehouse found, therefore, contrary to what he had previously accepted on authority as an undoubted fact, that the velocity in these wires, at least, was greatly dependent upon the amount of energy in the current employed.

The following are the general results:—

Velocity observations, recorded by the direct action of the current upon the paper, time calculated from the commencement of the earliest visible mark.

	Miles in a Second.
VOLTAIC CURRENT.	
Maximum velocity	1600 to 1800
Minimum	1000
MAGNETO-ELECTRIC CURRENT.	
Maximum velocity	6000
Minimum	3600

Velocity observations, recorded by means of "twin currents" received upon "relays," with local decomposition battery for printing.

MAGNETO-ELECTRIC CURRENT FROM INDUCTION COILS.	Miles in a Second.
Mean of 641 observations on 900 miles	4050
Mean of 4780 observations on 300 miles	4900
Gradual diminution of velocity observed in the progress of one long experiment occupying several hours, during which the battery employed (a small Grove's) was thoroughly exhausted—all other conditions remaining the same	5400 to 3600

ELECTRIC CONDUCTION AND INDUCTION.

Dr. Tyndall, in his seventh lecture on Magnetism and Electricity, delivered at the Royal Institution, has directed attention to the properties of Conduction and Induction. In the consideration of the property of induction, he reverted to some of the early experiments which exhibited the attractive and repulsive powers of electricity; and the effects of attraction and repulsion were explained to be owing to the peculiar power which excited electrics possess of inducing in all surrounding bodies a condition of electricity of the opposite kind. Thus, an excited glass rod, which is positive, induces negative electricity on all bodies within its influence; and as the opposite kinds of electricity attract each other, light substances that are capable of motion are drawn towards the glass; they there become charged, by conduction, with the same kind of electricity as the glass, and are then repelled. The effects of attraction and repulsion were illustrated in a remarkable manner, by tracing invisible figures with the knob of a positively excited jar on a slab of excited wax, and then dusting over it some powdered sulphur and red lead through a muslin sieve. The sulphur and the lead being in opposite states of electricity, they separated on the wax slab; one being attracted to the tracings made by the Leyden jar, and the other to the wax, showing distinctly by their different colours the figures that had been drawn. Dr. Tyndall pointed out the distinction between induced magnetism in soft iron and the induction of electricity; which exhibits an apparently strong contrast in those associated phenomena. In the induction of magnetism, there is always polarity, and when a magnet is broken in the middle, the two parts instantly become two magnets, each having a north and a south pole; but when electricity is induced, and the body under its influence is separated, one part remains electrified negatively and the other positively. This was shown by inducing electricity in two insulated metallic hemispheres, which were first placed together to form a sphere and afterwards separated, when the two bodies exhibited opposite electrical states. The peculiar influence of points in conducting electricity was next explained and illustrated. The concentration of the electric fluid on the surfaces of bodies increases as their extent diminishes; and at points it becomes so highly concentrated that it flies off readily to all surrounding bodies. This was shown by fixing a point to an electrometer, which had the effect of giving a charge to the gold leaves from a glass rod held at a considerable distance, the difference when the point was attached being that the leaves remained distended after the glass rod was removed. The effect is increased when bodies are heated, as was exhibited by placing a lighted pastile on the electrometer, which acted more sensitively than the cold metal point. The current of air that is felt issuing from a point, when fixed to an electrical machine, was explained to be owing to the rapid communication of positive electricity to the air immediately round the point, and the consequent repulsion of it from the positively electrified point.

PECULIAR PHENOMENON IN THE ELECTRO-DEPOSITION OF ANTIMONY.

Mr. G. Gore, in the *Philosophical Magazine*, No. 56, states: If a

piece of metallic antimony is connected by a wire with the positive pole of a small Smee's battery of one or two pairs of plates, and immersed in a solution of hydrochlorate of terchloride of antimony, *i. e.*, the ordinary chloride of antimony as prepared for pharmaceutical purposes, and a clean piece of sheet copper of similar size, or a little larger, connected by a wire with the negative pole of the battery, and immersed in the same liquid, at a distance of two or three inches from the antimony, a strong current of electricity will pass through the liquid, and metallic antimony will immediately be deposited all over the piece of copper, and will form a distinct coating in two or three minutes; if the power of the battery is too strong, the deposited metal will have a dull appearance, and less battery power should be employed, or the piece of antimony immersed to a smaller extent in the liquid; the deposit will then in a short time assume a fine bright appearance, somewhat similar to highly polished silver. If the process be allowed to continue for twenty-four hours, the coating of antimony will be at least half the thickness of a sixpence; and by continuing it for eight or nine days, I have obtained a continually bright and reguline deposit of upwards of half an inch in thickness.

If, during any part of the time the deposit is progressing, the deposited antimony be taken out and struck gently, or rubbed with any hard substance, such as metal or glass, an explosion occurs, with a small cloud of white vapour, sometimes with a flash of light, and nearly always with considerable heat, sufficient to burn one's fingers, melt gutta percha, burn paper, and even scorch deal wood quite brown, and invariably accompanied by fracture of the deposited metal; sometimes, if the process of deposition has been interrupted, and the deposited metal is not homogeneous, only a thin scale falls off; in such case the explosion and heat are less. In other instances, where the process was regular and the metal homogeneous, the fracture extended quite through the metal to upwards of one-eighth of an inch in depth.

I have observed this phenomenon in about nine instances, in several of which the explosion took place *even in the liquid*, by striking the deposit against the glass containing vessel; and in one instance it occurred after the metal had been well washed with dilute hydrochloric acid, dried, and had remained out of the liquid several hours.

The same phenomenon occurred with deposits obtained in a solution composed of one fluid ounce of the antimony liquid, and half a fluid ounce of a saturated aqueous solution of hydrochlorate of ammonia.

EXISTENCE OF AN ELECTRICAL ÆTHER THROUGH SPACE.

MR. GEORGE JAMES KNOX, in a letter to the Editors of the *Philosophical Magazine*, No. 61, says:—In a paper, entitled "On the Direction and Mode of Propagation of the Electric Force traversing Interposed Media" (*Philosophical Magazine*, 1840), I endeavoured to prove, from the experiments of Sir H. Davy, that an electric current consists in alternate states of induction and equilibrium of the particles of the medium conveying the current, the *intensity* of the current being proportional to the *rapidity of change* of induction and equilibrium, and consequently that the *mass* of oscillating æther surrounding the par-

ticles represents the *quantity*, while the *rapidity* of the oscillations represents the intensity of an electric current.

The *Philosophical Magazine*, No. 58, contains some very interesting experiments which were made by Mr. L. Clark, on the transmission of currents of electricity of varying intensity through 768 miles of gutta-percha wire, indicating a velocity of propagation of about 1000 miles in a second, which velocity is sensibly *uniform* for *all intensities from* 31 *cells to* 500; which results, Dr. Faraday remarks, "afford a fine argument in favour of the opinion of those who suppose the electric current to be analogous to the vibrations of air under the action of sonorous bodies."

The experiments of Professor Grove on the electro-chemical polarity of gases, where he obtains rings alternately bright and oxidated, showing effects of oxidation and reduction by the same current on the same plate, he considers as "analogous to the phenomena of interference in light; though doubtless, if this be a right view, the very different modes of action of light and electricity would present very numerous phenomenal distinctions."

The idea has lately been presented to my mind, that the oscillations of the electrical æther in combination with the particles of the medium conveying a current, produce undulations, not only in the æthers of light and heat, but also in another æther, which Dr. Draper calls the tithonic æther, but which, if experiment proves to be the case, should be more correctly termed the electrical æther.

Dr. Draper, in the year 1847, undertook a series of experiments upon the rays of light emitted by incandescent bodies, from which he concluded that when a platinum wire is heated by the voltaic pile or otherwise, it emits rays of light, which increase in refrangibility proportionally to the increase of heat, which he explains thus:—"As the luminous effects are undoubtedly owing to a vibratory movement executed by the molecules of the platinum, it seems from the foregoing considerations to follow, that the frequency of those vibrations increases with the temperature."

Sir David Brewster has observed, that in the spectra produced by the electric light, the chemical rays are more numerous than in those produced by the lime light.

The problem then to be solved is,—whether the chemical rays be produced *directly* by the oscillations of the electrical æther in the platinum wire, or *indirectly* by the heat produced.

This question might be resolved by observing the effect produced by voltaic piles of *different* intensities, the *heat* remaining *constant;* and if so, it would afford a strong argument in favour, not only of an oscillatory movement in the electrical æther in combination with the particles of bodies, but also of the existence of such an æther through space.

THE ELECTRIC TELEGRAPH IN INDIA.

Dr. O'Shaughnessy's Report (dated March, 1852), gives a description of the lines then at work. The over-ground lines specified by the Doctor differ materially from those used in England and America. No

wire is used, but a thick iron rod, ⅝ths of an inch in diameter, weighing one ton to the mile. The advantages of using thick iron rods are— 1, immunity from damage or fracture by wind or mechanical violence; 2, immunity from injury, if accidentally thrown down; 3, they cannot be broken or bent without great trouble; 4, by their mass of metal, they give so free a passage to the electric current that no insulation is required, and the rods are attached to the bamboos, posts, &c., without employing glass, porcelain, or any other non-conductor; yet through these lines they work without interruption, during tropical deluges of rain, with miniature batteries, consisting of 12 cells of platinum wires and zinc; 5, no tension is required, as in the case with wire lines; 6, the thick rods admit of rusting, that would be fatal to a wire line not coated with zinc; 7, rods are not more costly than wires, as, if imported direct, they would not cost more than 100 rupees per mile. For crossing the Hoogly river, 6200 feet wide, above Diamond Harbour, after several experiments, a gutta percha covered wire was laid, and under the river, secured in the angles of a chain cable. Dr. O'Shaughnessy goes on to describe the system of correspondence on these lines, which has proved highly successful. There are no interruptions on the lines, and night correspondence has been carried on with a certainty and rapidity not anticipated. The utmost degree of confidence was reposed in the management by the public, and the pecuniary returns were greater than the Doctor expected. It is necessary to use the simplest instruments possible, as in India they are apt to be deranged owing to the prodigious electric excitement of the atmosphere, and there are no mechanics at hand in the rural districts. In all the lines running north and south there is a natural current of electricity continually flowing; and this current deranges the polarity of the needles, confers permanent polarity on soft iron, and produces chemical stains on prepared tissues. Hence the necessity of simple and not complex instruments. The Court of Directors of the East India Company appear to have sanctioned the proposal to construct the telegraph works proposed from Calcutta to Agra, Bombay, Peshawur, and Madras; and in a despatch to the government of India, of the 2nd of May last, they pronounce the Reports on the progress of the works to be most satisfactory, while they entirely approve of the proceedings of the Indian government, and pass a high eulogium on Dr. O'Shaughnessy.

THE TRANSATLANTIC ELECTRIC TELEGRAPH.

THE Atlantic Telegraph is no longer a merely talked of project: although not yet realized, an European Company, of which Mr. Brett is a prominent member, is said to have now actually entered into contracts for the completion of the work by the 22nd of January, 1858. The length of the wires from Ireland to Newfoundland will be some 1750 miles: they will lie on the sandy plain, which the soundings of the United States' Government have shown to stretch from land to land for the whole distance, with the exception of 200 miles next to the Irish coast, where the bottom becomes irregular, and the water deeper. The actual distance is about 1600 miles only; but it will be necessary to make a detour with the wires in order to carry them round the banks,

where icebergs often ground, and where the cable might be broken by their weight and friction. The cable contains six wires, eight tons to the mile. Messrs. W. Kuper and Co. of London are the manufacturers. They mean to splice the ends of the portions carried to the spot in different steamers. An American Company propose to form the entire American portion of the telegraph from St. John's, Newfoundland, to New York. This part of the line will be 1200 miles in length, 71 miles of which will be under the Gulf of St. Lawrence. The cost of the whole is estimated at a million and a half of dollars. The wires across Newfoundland will make 400 miles of the line, running through a country hitherto unoccupied and unknown. In the cutting of the path, and other preparatory labours, the Company have had 600 men employed during the past year in that island alone. The cable to go under the Gulf of St. Lawrence contains three electric wires only, it being contemplated to lay down another of the same size when the European wires have been taken across, and the business between New York and London requires it.

An attempt to lay down a cable across the Gulf of St. Lawrence, seventy miles in length, to St. John's, Newfoundland, which would have reduced the interval for news between Liverpool and New York to six or seven days, has unfortunately proved unsuccessful. After forty miles of the cable had been run out, during a period of heavy weather, which had already occasioned many interruptions, the line parted, and had to be abandoned. It appears that, instead of a large steamer being employed, the cable was shipped on board a sailing barge, which was towed by a small steamer, and that the disaster is to be attributed to the difficulty of their keeping together in a rough sea.

The work is by no means abandoned. The engineers only await the return of another warm season to repeat their endeavours, as the months of June and July is the only time when the wires can be laid with safety. The land portion of the line, extending from Cape Ray to St. John's, a distance of 400 miles, is very near completion.

Chemical Science.

INFLAMMABILITY OF HYDROGEN.

It is said by Berzelius and others, that Hydrogen prepared in the dry way does not possess the property of inflaming by contact with spongy platinum. This phenomenon, first indicated by Faraday, having been attributed by Berzelius to an allotropic condition of the hydrogen, M. Baudrimont thought it worth while to repeat the experiment. For this purpose vapour of water was decomposed by red-hot iron, and the hydrogen thus produced (which is that said to be prepared in the dry way) was directed upon spongy platinum, which, as we had ascertained, possessed the power of igniting the ordinary gas. It was then found that it also inflamed the gas obtained from the vapour of water. On collecting some of this same gas in a bottle with a ground glass stopper, and afterwards driving it out by means of a current of water, so as to direct it upon a small mass of spongy platinum, the hydrogen was again ignited. If, therefore, this gas may acquire various allotropic conditions, these cannot be proved by the fact advanced by Faraday, and which we have not been able to realise.—*Philosophical Magazine*, No. 55.

NASCENT OXYGEN.

M. Houzeau has made the important discovery that Nascent Oxygen can be produced abundantly by a purely chemical process, and then has properties completely similar to those of ozone. His process consists in placing sulphuric acid in a tubulated balloon, to the neck of which a narrow tube, plunging under the water of the pneumatic trough, is attached. Peroxide of barium is then thrown in, and the gas immediately disengaged. In some instances it is necessary to raise the temperature to 100° Fahr.; but it must not exceed this, for when exposed to a higher temperature, the oxygen passes into its ordinary condition.

Nascent oxygen is a transparent gas with a strong odour, which at first is not disagreeable, but becomes unsupportable when it has been smelt for some time. It may be respired if care be taken, but if introduced in large quantity into the system, it produces nausea and vomiting. When heated to 107° it loses all its active properties. In presence of water it oxidises most of the metals, including silver. It peroxidises most metallic protoxides, and converts arsenious into arsenic acid; the alkalies and acids act powerfully upon it. It oxidises ammonia with great rapidity, and if a rod dipped in a solution of that alkali be introduced into the gas, the vessel is instantly filled with white fumes of nitrate of ammonia. It immediately ignites the non-spontaneously inflammable phosphuretted hydrogen; and hydrochloric acid in solution in water is instantly decomposed by it, with formation of water and evolution of chlorine. It decomposes iodide of potassium, and bleaches vegetable colours. When passed slowly through a tube containing

spongy platinum, asbestos, cotton wool, or other porous substances, it is immediately converted into common oxygen. The author, in concluding his paper, remarks that peroxide of barium is not the only substance containing oxygen in the nascent state; but, on the contrary, that it exists in that condition in most, if not all, compounds; and the reason why we do not obtain it from other substances is, that the conditions of our experiment do not permit its evolution in its primitive state, the heat, light, or other means we employ converting the active oxygen into its inert form.—*Comptes Rendus*, vol. 40, p. 947. [The author promises in a future paper to compare his nascent oxygen with Schonbein's ozone. It is to us obvious, however, that they are identical, and the experiments of M. Houzeau must be considered as conclusive evidence in favour of the view taken by Berzelius, that ozone is really an allotropic oxygen; and it is to be regretted that M. Houzeau had not employed that term in place of nascent oxygen, which chemists have been in the habit of using in a somewhat different sense.—*Edinburgh New Philosophical Journal*, No. 3.]

CONSTITUTION AND PROPERTIES OF OZONE.

Dr. Andrews has communicated to the Royal Society a paper on this subject. Having confirmed by new experiments the fact that Ozone is formed by the action of the electrical spark on pure and dry oxygen, the author proceeds to institute a comparison between the properties of ozone derived from different sources. These he finds to be in every respect the same. Thus ozone, however prepared, is destroyed, or rather converted into ordinary oxygen, by exposure to a temperature of about 237° C., and catalytically, by being passed over peroxide of manganese, no water being formed in either case; it is not absorbed by water, but when sufficiently diluted with other gases, is destroyed by agitation with a large quantity of water; it is also, contrary to the common statements, destroyed by being agitated with lime-water and baryta-water, provided a sufficient quantity of those solutions be used; it has always the same peculiar odour; it bleaches without producing previously an acid reaction; it oxidizes in all cases the same bodies, &c.

From the whole investigation the author draws the conclusion, "that ozone, from whatever source derived, is one and the same substance, and is not a compound body, but oxygen in an altered or allotropic condition."—*Philosophical Magazine*, No. 68.

HEAT WITHOUT FUEL.

The problem of acquiring Heat without Fuel appears to have been solved by the invention of the machine of MM. Beaumont and Mayer, with which, by means of friction alone, they can make water boil. The machine, which may be seen at work at their establishment on the Quai Valmy, contains 400 litres of water, which is made to boil in two hours. A cone of wood, which turns in a cylinder so as to produce the necessary friction, is covered with tow, and that tow, in order that it may not catch fire, is kept constantly moistened by a stream of oil which runs on it. The heat gradually increases, until at last steam is generated.—*Galignani.*

PREPARATION OF OXYGEN BY THE DECOMPOSITION OF WATER.

THE following suggestion of a mode of Preparing Oxygen on a large scale is published by M. D. Muller, in the *Comptes Rendus* of April 16.

Two very important facts served as a starting point—1. An aqueous solution of chlorine, contained in a glass receiver, is gradually converted into hydrochloric acid; the oxygen remains free. 2. In all circumstances, the chlorine and hydrogen combine immediately under the influence of heat. There is, therefore, nothing more natural than to turn this great affinity of chlorine for hydrogen to account, in order to decompose steam at a high temperature. Under the influence of heat, the chlorine combines with the hydrogen of the steam, and is converted into hydrochloric acid in the gaseous state; the oxygen remains free, part of which might combine with the chlorine and form perchloric acid; but the greater part remains free, mixed with hydrochloric acid gas. On passing the mixture into a vessel containing water, the gaseous hydrochloric acid is immediately dissolved, and the oxygen may be collected alone. The temperature proper for this operation is about 120° C. (248° F.)

NEW FORM OF CYANIC ACID.

BARON LIEBIG, in a communication to the British Association, says: In the course of some experiments on the fulminate of mercury, I observed that that compound, when kept boiling in water, changed its colour, and lost its fulminating properties. On examining the change that had taken place in the composition of the fulminate, I discovered a new acid, which had exactly the composition of cyanuric acid, but which differed entirely from that acid in its properties, and in the properties of the salts which are produced with the alkaline bases—salts remarkable for their beauty and for the distinctness of their crystalline form. Taking for the equivalent of hydrated fulminic acid the formula C2, NO, HO, the new acid is produced in a very similar manner. The elements of three equivalents of fulminic acid unite to form one equivalent of the new acid, to which I shall give the name of fulminuric acid. This acid is monobasic. Its salt of silver is soluble in hot water, and crystallizes from it in long, silky, white needles. The alkaline salts of the new acid are very easily prepared by boiling the fulminate of mercury with an alkaline chloride. The fulminate of mercury is first dissolved; then gradually two-thirds of the oxide of mercury precipitates, and the alkaline fulminate, with a certain quantity of chloride of mercury and potassium, remains in the solution. By employing the chloride of sodium, or the chloride of barium, we obtain, of course, a salt of the new acid, with a base of soda or of barytes. With chloride of ammonium an ammoniacal salt is obtained, the crystals of which are distinguished from all others by their adamantine brilliancy, and their high degree of power and lustre. These crystals belong to the Klinerhombic system, and possess double refraction almost as strongly as Iceland spar. The hydrated acid is easily obtained by decomposing the basic lead salt by means of sulphuretted hydrogen. It has a strongly acid re-action, and when reduced by evaporation to a state of syrup, it is transformed by degrees into a crys-

talline mass, which dissolves in alcohol, and which, by the action of acids is changed into carbonic acid and ammonia.—*Athenæum*, No. 1456.

DENSITY OF SULPHURIC ACID.

MR. STEWART has read to the British Association a paper "On the Density of Sulphuric Acid," and in which he endeavoured to show that the points of greatest contraction of a mixture of water and sulphuric acid corresponded with definite hydrates.

SOLUBILITY OF CARBONATE OF SODA.

PAYEN has made the observation that Carbonate of Soda, like the Sulphate, has a point of maximum solubility. In fact the quantities of the crystallized carbonate dissolved at 57° Fahr., 97°, and 219°, while the boiling points of the saturated solution, are as follows :—

57°	60·4
97°	833·0
219°	445·0

It is remarkable that this peculiarity of so familiar a salt should have so long escaped the attention of chemists.—*Annales de Chim. et de Physique*, vol. xliii.

ON TABASHEER. BY M. GUIBOURT.

TABASHEER is a siliceous concretion found in the interior of the stem of the large Indian Bamboo (*Bambusa arundinacea*, Schreb.). The attention of the orientals was first directed to this substance by the writings of the Arabian physicians. The Turks and Arabs only know it under the name of Tabasheer, which is of Persian origin. In India it has other names, such as *Vedroo-paloo* (bamboo-milk), *Vedroo-carpooram* (bamboo-camphor), and *Mangil-upoo* (bamboo-salt). The orientals regard it as one of the most valuable medicines; whilst it is only interesting to us from its being a concretion of silica deposited in a vegetable organism, which has some resemblance to the hydrophate of Haüy.

Tabasheer is evidently a mass produced from a jelly by desiccation. To obtain an insight into its production, M. Guibourt has investigated the inorganic constituents of the bamboo. The small quantity of pith which is seen when a bamboo is split longitudinally, contains iron, potash, lime, and silica. The ashes of the wood consist of—

Soluble salts.		Insoluble salts.	
Carbonate of potash	1·9872	Phosphate of lime	0·0928
Sulphate of potash	0·2905	Phosphate of iron	0·0130
Phosphate of potash	0·1593	Silica	0·0408
Chloride of potassium	0·0766	Loss	0·0371
Silica	0·0204		0·1837
	2·5340		

The author found that the silica occurred in different quantities in different parts of the cane. The pith contained 0·448 per cent. The inner wood held much less, and the greatest proportion occurred in the external wood. Consequently the author thinks the formation of

tabasheer is easily explained in the following manner: at the time when the straw is developed, the outer wood has no longer any necessity for silica, which is carried inwards and deposited in the cavity of the straw.—*Journ. de Pharm.;* abridged from the *Philosophical Magazine*, No. 65.

PROPERTIES OF ARSENIC.

It is a very common practice in some parts of the continent—in Germany, Hungary, and the Tyrol—for persons of all classes to take Arsenic in minute quantities as a tonic and stimulant. It invigorates the frame, and has a remarkable effect upon the chest, enabling them to climb steep hills with ease; it also imparts a brilliant bloom to the complexion, and a general appearance of youthfulness. The too-frequent practice of giving arsenic to horses in England is well known; and the beauty of coat, excellence of wind, and appearance of good health produced by it, while the arsenic is administered in its proper small quantity, at exactly regulated intervals, is evident; but, as the practice is mostly resorted to by grooms without the knowledge of their masters, the want of care and exactness, and the frequent change of servants, have occasioned the loss of many valuable animals, whose deaths have remained in mystery; for it is a wonderful fact with regard to the taking of arsenic, that if it be discontinued, the constitution breaks up with precisely the same symptoms which are produced by arsenical poisoning, and the sufferer (for the effect is the same on the man as on the animal) dies a miserable death from want of the arsenic, with every appearance of being the victim of poison.—*Correspondent of the Times.*

SPONTANEOUS COMBUSTION.

Dr. Inman has read before the Literary and Philosophical Society of Liverpool a larger and more complete account of what is known of the circumstances and causes of Spontaneous Combustion than we have yet seen.* It also contains a Report of various experiments by the author himself, which tend still further to throw a light on this heretofore nascent and somewhat obscure subject. In testing the influence of different substances on painters' oil, for instance, in evolving heat and producing spontaneous combustion, Dr. Inman found that charcoal had the most powerful influence; indeed, of this fact painters are already aware, inasmuch as they know that lamp-black and their oil have at once to be ground, or they will ignite even in a few minutes. Next to charcoal stood sponge, then worsted, saw-dust, cotton-wool, tow, and shavings. The precise measure and time in which these various substances absorb oxygen when mixed with the oil, are noted in a tabular form. We were rather surprised to find worsted, an animal substance which merely singes and does not tend, under ordinary circumstances, to burst into flame when fire is applied, ranking here next to charcoal and before cotton-wool; but our impression of the greater risk of spontaneous

* Since published, as *Spontaneous Combustion, and the Best Means of Extinguishing Fire.* By T. Inman, M.D. London: Ward and Lock, Fleet-street. 1855.

combustion from cotton than from animal wool is nevertheless borne out by these experiments; for Dr. Inman afterwards remarks, in reference to cotton, though not specially to animal wool, that in effect, and on account probably of the relative forms and surfaces, and access to air, of the different substances, "it is far more difficult to get small quantities of tow to ignite, even under very favourable circumstances, than cotton-wool: indeed, we may say that when the quantities used are small, it is difficult to procure actual ignition with anything but cotton-wool: when the quantity used is large, it is only a question of time." One point well worthy of notice, is the enormous amount of oxygen absorbed by painters' oil *in the first twelve hours*, compared with the ultimate quantity. This, the writer suggests, may explain how it is that fires so frequently break out within a *very brief* period after workmen have quitted premises where they may have been using painter's oil, and have left their greasy aprons, rags, or pieces of cotton on which their hands may have been wiped near to each other, *or to a warm steam-pipe, or stove not yet cold* (or in a warm summer-day or sunshine we might add); or that some few drops of oil have extended from the cans to some dust, sawdust, shavings, and the like. In such cases, we have the materials provided, and the train laid, as it were, for a conflagration which will burst out in an hour or two. Professor Graham refers to instances of olive oil igniting upon sawdust; of greasy rags from butter heaped together taking fire within twenty-four hours; of the spontaneous combustion of tape-measures, covered with oil varnish; and even of an oilskin umbrella put aside in a damp state. The ignition of such materials, generally, it must be noted, is greatly favoured by a slight warmth, such as the heat of the sun.

Dr. Inman suggests, for the extinction of fires, in warehouses especially, and in ships, the previous arrangement of iron spouts, commencing outside in a convenient position, and running into the interior of each apartment or space likely to be exposed to the occurrence of fire, either spontaneously, or communicated by accident or otherwise. Through these spouts such gaseous substances as carbonic acid, or nitrogen as from the Fire Annihilator, might then, he remarks, be poured in without the necessity of opening doors, windows, or hatches, and of so admitting the air which inflames and increases the combustion. In certain cases, he adds, even the water-hose might be fitted on to the ends of such pipes, and deluge the burning materials.—*Builder*, No. 651.

ON A STRONGLY FLUORESCENT FLUID. BY RUDOLPH BÖTTGER.

Dr. Böttger has informed Professor Poggendorff, that a solution of platino-cyanide of potassium possesses the property of fluorescence in a still higher degree than sulphate of quinine. The solution of the metallic salt fluoresces with a yellowish light, resembling one of the colours exhibited by its dichroitic crystals.—Poggendorff's *Annalen*.

HOME-MADE CHLORIDE OF LIME.

Professor Nash recommends the following method:—Take one barrel of lime, and one bushel of salt. Dissolve the salt in as little water as will dissolve the whole. Slack the lime with the water, putting

on more water than will dry-slack it, so much that it will form a very thick paste: this will not take all the water. Put on, therefore, a little of the remainder daily, until the lime has taken the whole. The result will be a sort of impure Chloride of Lime, but a very powerful deodorizer, equally good for all out-door purposes with the article bought under that name at the apothecary's, and costing not one twentieth part as much. This should be kept under a shed, or some outbuilding. In reference to this composition, "an Analytic Chemist" states in the *Builder*, that he has tried the mixture recommended by Professor Nash, but has found that "it is of less value than quicklime alone for sanitary purposes," remarking, that "when lime and chloride of sodium (common salt) are brought together in the presence of water, the chlorine of the latter and the oxygen of the lime mutually change places, with the production of chloride of calcium and caustic soda (NaO), the latter immediately attracting water, to form hydrate of soda (HO NaO), in an equation, thus — NaCl + CaO + HO = CaCl. + HO NaO. Neither soda nor chloride of calcium," he adds, "are of the slightest use for deodorizing or disinfecting purposes, nor is a mixture of the two of any more value. If sulphuric acid be added to the "home-made chloride of lime," it neutralizes the soda, combines with the lime, and disengages hydrochloric acid, which *alone* will not answer the purpose required."

The same Correspondent recommends the following mixture as about the best for disinfecting purposes :—Commercial chloride of lime, 4 lbs.; peroxide of manganese, 1 lb.; powdered charcoal, 5 lbs. The whole cost of 10 lbs. of this mixture will, he says, be 1*s.* 3*d.* retail. In cases of cholera, fever, &c., he fills, with his mixture, a large flower-pot (the hole stopped with the porous plaster of Paris), and sets it in a vessel containing vinegar and water. In reference to his previous communication, the Correspondent states that, in practice, he finds that the chloride of sodium and lime of the "home-made chloride," mixed with water in the way indicated, do not even produce chloride of calcium until the lime gradually absorbs carbonic acid from the air.

ANÆSTHETIC PRINCIPLE OF FUNGI.

Mr. Thornton Herapath, in a communication to the *Philosophical Magazine*, No. 63, observes :—"The smoke of the puff-ball, it is well known, has been long employed in some parts of the country, by apiarists, for stupefying bees. In a paper 'On the Anæsthetic Properties of the *Lycoperdon proteus*, or common Puff-ball,' which was read before the Medical Society of London, in 1853, Mr. B. W. Richardson called particular attention to this fact, and stated that the fumes of the burning fungus produced the most perfect anæsthesia, not only in insects, but also in dogs, cats, rabbits, and probably in all the larger animals, and might consequently be applied as a substitute for the vapour of chloroform and æther in producing insensibility to pain in surgical practice." Mr. Herapath, with the view of ascertaining the exact nature of the active principle of narcotism in the above and similar cases, has made several experiments. He has specially examined "the fumes for carbonic oxide, by agitating them with an acid solution of

chloride of copper, and also by absorbing the carbonic acid, ammonia, and oxygen, by means of lime-water, diluted muriatic acid, and a solution of the protosulphate of iron saturated with nitric oxide gas, when indications of the presence of carbonic oxide were readily obtained; the fumes, after agitation with the solution of chloride of copper, no longer induced narcotism; whilst those, on the contrary, which had been treated with the other solvents, were more than ordinarily powerful, and rendered an insect insensible much more quickly than before; they also burnt with a blue flame, and possessed all the well-known characters of the oxide of carbon. The correctness of this conclusion was, moreover, confirmed by experimenting with carbonic oxide prepared by acting on oxalic acid with oil of vitriol, and passing the gas evolved through caustic soda-ley. Even when largely diluted with air, it still continued to produce insensibility in insects, and acted in every way like the purified fumes of the *Lycoperdon*.*

"It is not difficult to understand how carbonic oxide is formed by the ignition of the fungus, as this gas is invariably produced in larger or smaller quantity when certain organic substances are decomposed by heat, though some yield it in greater proportion than others; consequently, as might have been anticipated, I find that the fumes of several other fungi act in the same manner towards animals as those of the *Lycoperdon proteus*. The principal of those to which I allude are the common *Lycoperdon* of the druggist, *L. giganteum*, and the mushroom, *Agaricus campestris*."

THE ORDEAL BEAN OF OLD CALABAR, WESTERN AFRICA.

Dr. Christison has communicated to the Royal Society of Edinburgh the following paper:—

"In various parts of Western Africa it appears to be the practice to subject to the ordeal by poison persons who come under suspicion of having committed heinous crimes. On the banks of the Gambia river the poison used for the purpose is the bark of a leguminous tree, the *Fillæa suaveolens* of MM. Guillemin and Perottet. In the neighbourhood of Sierra Leone it is the *Erythrophleum guinĕense*, which some botanists have considered identical with the former species. On the Congo river, Captain Tuckey found that either this species, or an allied species of the same genus, was in constant use for the same purpose. These barks, when their active constituents are swallowed in the form of infusion, sometimes cause vomiting; and then the accused recovers, and in that case is pronounced innocent. More generally the poison is retained; and then the evidence of guilt is at the same time condemnation and punishment; for death speedily ensues.

"In the district of Old Calabar, the poison used for the trial by ordeal is a bean, called *Eséré*, which seems to possess extraordinary energy and very peculiar properties. It has been lately made known to the missionaries sent by the United Presbyterian Church in Scotland to the native tribes of Calabar; and to the Rev. Mr. Waddell, one of these

* See *A Treatise on Poisons*, by Professor Christison, fourth edition, p. 827, for an account of the peculiar effects produced by the inhalation of the oxide of carbon.

gentlemen, the author was chiefly indebted for the materials for his experiments, as well as for information as to its effects on man. According to what the missionaries often saw, this poison is one of great energy, as it sometimes proves fatal in half an hour, and a single bean has proved sufficient to occasion death. None recover who do not vomit it. The greater number perish. On one occasion forty individuals were subjected to trial, when a chief died in suspicious circumstances, and only two recovered.

"The author found the bean to present generally the characters of a *Dolichos*. It has been grown at his request both by Professor Syme and at the Edinburgh Botanic Garden by Mr. M'Nab; and it proves to be a perennial leguminous creeper, resembling a Dolichos, but it had not then flowered. The seed weighs about forty or fifty grains. It is neither bitter, nor aromatic, nor hot, and differs little in taste from a haricot bean. Alcohol removes its active constituent, in the form of an extractiform matter, amounting to 2·7 per cent. of the seed. The author could not obtain an alkaloid from it by any of the simpler processes for detecting vegetable alkaloids.

"By experiments on animals, and from observation of its effects on himself, the ordeal bean has a double action on the animal body: it paralyses the heart's action, and it suspends the power of the will over the muscles, causing paralysis. It is a potent poison, for twelve grains caused severe symptoms in his own person, although the poison was promptly evacuated by vomiting, excited by hot water. The alcoholic extract has the same effect and action with the seed itself."

NEW METHOD OF DETECTING ADULTERATIONS OR MIXTURES OF COFFEE AND CHICORY.

The following paper, by Mr. John Horsley, of Cheltenham, has been read to the British Association:—

I beg to offer an exceedingly sensitive test in the bichromate of potassa. This salt will be found to produce no discoloration of an infusion or decoction of chicory; on the other hand, the *most dilute* solution of coffee gradually becomes changed to a *deep porter brown colour*, which is not at all connected with the colouring matter of coffee, but with the gallic acid existing in the berry, as a decoction of the white unroasted berry will produce a similar result. This may be proved by boiling the berries in water, and then throwing in a crystal of the chromic salt, when the liquor soon becomes brown, and the berries stained throughout, which is not the case with caffein or tannin.

It may be urged that if this salt reacts thus with pure coffee, will it not proportionally so on a mixture of that article with chicory? This then affords us an excellent means not only of detecting coffee, but estimating its quantity by a kind of approximation test.

If we add to the mixture of chicory and coffee, which has been boiled with the bichromate of potash, a few grains of sulphate of copper, and then boil the liquid, we cause the formation of a flocculent precipitate of a more or less deep sepia brown colour—the intensity of which varies with the quantity of coffee contained—from which, by a

series of experiments with known quantities, it is easy to adjust a *graduated standard of tints* as follows :—

All Coffee.	Three-quarters Coffee.	Half Coffee.	Quarter Coffee.	All Chicory.

The following will be found to be the best method of procedure :—

Take an equal weight of chicory and coffee, and make *separate* infusions or decoctions in a given quantity of water ; filter the liquors, put them into vials, and label respectively.

Then take a teaspoonful of the infusion of chicory, and dilute with water until the liquid be of a *brown sherry wine colour ;* boil this in a whiteware dish, and add a small fragment of crystallized bichromate of potassa : the liquid will be scarcely altered in colour.

Next treat a similarly diluted infusion of coffee ; boil, and throw in a fragment of bichromate : the liquid will now assume a deep porter-brown colour, a reaction which is very decided.

By the addition, as before stated, of a few grains of sulphate of copper and boiling, a precipitate will be obtained from *both* infusions, but that from chicory, if viewed in a glass vessel, is of a *clayish yellow* colour, whilst the precipitate from coffee liquor is *sepia brown.* By thus noticing the shades of the precipitates when mixtures of chicory and coffee are the subject of investigation, we are enabled to judge of the quantity of coffee as well as chicory from the reactions which take place, and a reference to the scale of tints.

M. Lassaigne has noticed the reaction which takes place when a persalt of iron is added to an infusion of coffee.

A few drops of tincture of the sesquichloride of iron imparts to it a dirty blue green, but I do not find, as M. Lassaigne states, that a precipitate forms. This reagent does not produce any sensible change with an infusion of chicory.

Again, the di-acetate of lead produces with pure chicory a deep *brown* gelatinous precipitate : but with coffee a gelatinous *grey-coloured* precipitate. No reagent, however, that Mr. Horsley is aware of, is so decided in its character as that which he has proposed.

TO MAKE RANCID OIL SWEET.

A CORRESPONDENT of the *Builder*, No. 651, gives these results of his experiments upon Rancid Oil.

The following substances will *prevent* oil from getting *rancid :*—

1. Sweet spirits of nitre. A few drops added to the oil. The effect is due to the *nitric acid* of the spirit, oxidizing everything but the oil itself. The *hydrogen* has *nothing* to do with it.

2. Creosote appears to answer even better than the last.

3. Methylic alcohol ("comm. wood-spirit"), if added in small quantity to oil, will prevent its putrefaction, probably from the creosote, &c., it contains.

4. Hypochlorite solutions. The hypochlorite of soda is about the best, but a little *strong* solution of chloride of lime does very well, shaken up with the oil : when required for use, the oil may be decanted

from the top, or drawn off with a syphon; or let the mixed *oil* and *solution* be poured upon a circular filter, *thoroughly wetted with water*, and placed in a funnel, when the *solution* will pass through the filter, the *oil* being left. (Any liquid which does not perfectly mix may be separated in this manner; the filter-paper to be previously wetted with the fluid intended to pass through).

5. Small pieces of charcoal, soaked with diluted nitric acid, I have found to possess similar properties to the above.

Substances that will make rancid oil sweet:—

1. Sweet spirits of nitre.
2. Creosote (*very uncertain*—cannot be depended on).
3. Methylic alcohol (*very uncertain*—of little use).
4. Hypo-chlorites (*quite effectual* in a few hours; in a few minutes if boiled: the *dry salts* are of little use).
5. Peroxide of manganese (very good).
6. Animal charcoal (very good, but takes a few days, unless boiled with the oil).
7. Charcoal (of no use unless boiled with the oil: that from *beech-wood* is best).

WENTWORTH L. SCOTT.

BREAD-MAKING.

DR. MACLAGAN has read to the British Association a paper "On the Composition of Bread." He gave the results of some experiments which he himself had made. The amount of moisture in bread was less, and consequently the nutritive value greater, than was generally allowed. The late Professor Johnson had stated that a sack of flour produced one hundred quartern loaves. But, according to his (Dr. Maclagan's) examination, the sack of 380 lbs. gave 94¼ loaves of bread; 100 lbs. of flour giving 231 lbs. of bread. The majority of bakers were of opinion that the sack produced, on an average, 92 loaves, and there was no great discrepancy between this and the result of his own analysis. Unfermented bread contains, of dry flour, 60; moisture, 10; water added by baker, 30. 100 lbs. of flour will give 143 lbs. of bread, and a sack of flour will yield 100½ quartern loaves of unfermented bread.

Baron Liebig made a few observations on a new mode of making bread introduced into Germany. Lime-water had been used in the preparation of the dough, and the loaf was rendered still more nutritive than that made by the common mode. Dr. Playfair said the Section were much indebted to Dr. Maclagan for his communication. Much discrepancy existed among analytic chemists on the subject; but he believed Dr. Maclagan had arrived at pretty accurate conclusions.

CONDITION OF THE ATMOSPHERE DURING CHOLERA.

A PAPER on this subject has been read to the British Association by Dr. R. D. Thomson. The chemical condition of Cholera Atmospheres is a question of intense interest in the subject of public health; but, with the exception of the unpublished experiments of Dr. Prout in 1832, comparatively little attention appears to have been bestowed on it. One of the most striking circumstances connected with the

occurrence of the disease is, that no change very palpable to the senses prevails, and even one may have remarked that the weather has usually been exceedingly agreeable. In London, at St. Thomas's Hospital, the neighbourhood of which afforded a large supply of cholera cases, the relative weight of the air in August, 1854, a cholera month, and in August, 1855, when the metropolis was in an extremely healthy condition, is exhibited in the following table, in grains per cubic foot:—

1854. Week ending	Weight of Cubic Feet in Grains.	1855. Week ending	Weight of Cubic Feet in grains.
August 5	522·9 grains	August 4	516·9 grains
„ 12	526·7 „	„ 11	524·3 „
„ 19	595·0 „	„ 18	525·9 „
„ 26	523·5 „	„ 25	519·2 „
Sept. 2	525·1 „	Sept. 1	523·0 „
„ 9	530·3 „	„ 8	531·6 „
Mean	525·6 „	Mean	523·5 „

The result, as deduced from this table, which has been calculated approximately from the barometric pressure, and dry and wet bulb thermometer, is analogous to that obtained by Dr. Prout in 1832, as the author was informed by himself. Corresponding observations have been made at Greenwich by Mr. Glaisher, and the same conclusions arrived at; from which it would appear that this superior weight of a given bulk of air was not a local phenomenon, but was diffused to considerable distances; and the character distinguishing September, 1854, from the corresponding period in 1855, was the absence of any atmospheric action on ozone test-paper in the former season, while during the present year (1855) the oxidizing influence of the air has never been absent at St. Thomas's Hospital. During September, 1854, however, when no ozone could be detected in London, its action was sometimes faintly and often very strongly marked at Lewisham, near Greenwich. Throughout the same periods the air was exceedingly stagnant: and it has since been observed by Mr. Glaisher, and also at Vienna, that rapid atmospheric movement is pretty constantly accompanied by an oxidizing condition of the air.

With reference to the chemical composition in the atmosphere of inhabited localities and of malarious districts, experiments have usually been conducted on the constitution of the gases which enter into the composition of the air. But the results seem to have thrown little light on the possibility of the production from such causes, of any disease characterized by a regular sequence of symptoms. So far as our knowledge warrants, gases can either act only as asphyxiating media by the exclusion of oxygen, or as slow or rapid poisons. The cause capable of inducing a disease formed on a peculiar type, analogy leads us to infer must be an organized condition, either in a solid form or in a finely-diffused or vaporific state. The fact observed, that in malarious atmospheres sulphuric acid speedily becomes black, also points to the propriety of examining the air in such situations with the view of filtering from it solid or condensible matter. In the epidemic of 1849-50, the author examined the exterior air of an infected district with this object in view, to the extent of many cubic feet, but the result was

comparatively negative, and led to the inference that the examination of large masses of air could alone hold out any prospect of a successful issue. For this purpose air was passed through carefully-prepared distilled water contained in Woulfe's bottles by means of a large aspiratory apparatus of the capacity of sixteen cubic feet, which was kept constantly in action during the day for several months. Occasionally, freezing mixtures were applied to portions of the apparatus, and a tube, filled with pumice moistened with sulphuric acid placed next the aspirator, completed the series. A range of tubes conducted the air from a cholera ward into the aspirator. The ward was 32 feet long, 20 feet wide, and 9 feet high. The air was drawn from the centre of the ward near the ceiling; and when the apartment was filled with cholera patients, the air, after traversing several layers of distilled water, was speedily cleared by the sulphuric acid, and deposited a variety of solids in all the Woulfe's bottles, which could even be detected in some measure by the eye. The objects consisted of blue and red cotton fibres from the dresses of the inmates, portions of hair, wool, fungi, sporules of fungi, abundance of vibriones or lower forms of animal life, with particles of silica and dirt. In this and all the experiments conducted on the air of closed apartments, the distilled water was rendered strongly acid from the presence of sulphuric and sulphurous acids derived from the products of gas and coal combustion. The distilled water employed in these experiments was boiled for some time previous to being introduced into the apparatus, and was divided into two portions; one part being placed in a stopped bottle beside the Woulfe's bottles, through which the air was conducted, the sediment, if any, being afterwards examined and compared with that resulting from the experiment. When the ward was partially full, vegetable epiderm, vegetable cellular tissue, fragments of wood, cotton, linen, vegetable hairs, a sponge spicula, minute fungi, spiral vessels, sporules, spore cases, animal epithelium, oil globules, and silicious particles were detected; while vibriones were entirely absent, or at least mere traces could be discriminated. This is an interesting result, since in the first case only 98·6 cubic feet were examined, and of the partially empty ward 240 cubic feet passed through the apparatus. When the ward was empty, cotton fibres, wool, a trace of fungus, with carbonaceous and silicious particles, were alone discernible, the amount of air examined being 304 cubic feet. The air external to the ward and in the immediate neighbourhood afforded from 560 cubic feet one cotton fibre, one of wool, a crystalline body—probably a sponge spicula, sporules, beautiful mycelia of fungi in various stages of development, and some carbonaceous matter. The distilled water in this instance likewise yielded a strongly acid reaction, produced by sulphur acids.

The possible influence of sewer atmospheres predicated interesting results from examination of such air: accordingly, it was found that the predominating feature of this experiment was animal life in the form of swarms of vibriones in various stages of advancement. The chemical re-action in this case, unlike that in the preceding experiments, was invariably alkaline, due to the evolution of ammonia from the nitrogenous matters contained in the sew-

age liquors. These experiments render it sufficiently obvious that organic living bodies constantly surround us in close apartments; particularly that animal matter, under certain circumstances, is likewise diffused through such atmospheres. They fail to point out any matter capable of communicating cholera from one individual to another through the medium of the air, and therefore are so far important to the public; but they show that foreign animal matter, injurious to health, may speedily be concentrated in certain localities, which will undoubtedly assist in the production and propagation of disease in conjunction with meteorological conditions. Pathological investigations, carefully conducted by the author's colleague, Mr. Rainey, detected in one case an entozoon in the glottis or upper part of the air-passage, the only analogue of which has been found in the substance of the muscle of animals, which would seem to indicate that the germ of this creature had been derived from the atmosphere, or at least from external sources. It is intended that these experiments, which are tedious and laborious in their character, shall be extended to other atmospheres, so as to obtain comparative series of views, so to speak, of air modified by the influence of different diseases.

SANITARY USE OF CHARCOAL.

Dr. Stenhouse has delivered, at the Royal Institution, a lecture on this subject, in which he urged the importance of Charcoal as a Destroyer of Noxious or Infectious Effluvia. If all be true that is said as to the extraordinary *extent* of the disinfectant or detoxicant powers of charcoal, we think it is questionable whether the mere accommodation alleged to be afforded in its "pores" for immense quantities of gaseous or atmospheric combinations, is capable of explaining these powers; but its combinations and destruction of noxious gases are ascribed to a power possessed by it of promoting the slow combustion of the gases, irrespective, in great measure, of mere porosity. Its action, as we observe, is now compared by Dr. Stenhouse himself to that of platinum in promoting the combination of hydrogen with oxygen, an action which is probably connected with electrical agency. The more porous the substance, however, the more points of action of course there will be; but the mere capacity of such pores for *holding* a certain quantity of the gases does not appear to be quite a satisfactory explanation *per se* of the alleged extent of the action. The Respirator was one of the chief forms brought by the lecturer under notice. This, he said, he had purposely refrained from appropriating to himself by patent. Dr. Sutherland desired to take with him 500 of these to Constantinople, but he is said to have been prevented doing so by official routine. The use of bandages or coverings holding charcoal over wounds, and so absorbing and destroying putrid effluvia escaping from the wounds, and infecting the atmosphere of the hospital, would, we think, be no less important and sanative than the use of the Respirator itself. Charcoal, according to Dr. Stenhouse, destroys the efficacy of the manures which it deodorizes.*—*Builder.*

* See also *Year-Book of Facts*, 1855, page 214.

THE CAMPHOR OF COMMERCE.

CAMPHOR is a vegetable gum, semi-transparent and colourless. It is exceedingly volatile. When exposed to the air, it flies off in vapour. On account of its strong aromatic smell, it is much used to preserve cabinets and clothes from moths and other insects. From its strong smell has arisen the idea that it is a preservative against infective disorders; as it is poisonous, disease is more liable from the camphor than from infection. Although camphor is dissolved in water only in a small quantity, sufficient, however, is taken up to give the water both its aromatic odour and bitter taste. If some shavings of camphor are thrown on the surface of perfectly clean water in a large basin, the pieces immediately begin to move rapidly, some round on their centres, others from place to place. The cause of these motions is unknown. Camphor exists in many plants, but is chiefly derived from two, one a native of China and Japan, much resembling the laurel. It is obtained by chopping the leaves, branches, roots, &c., into small pieces and placing them in a still, with water. The other camphor-tree is a native of Borneo and Sumatra. The camphor is obtained by splitting open the tree, when it is found in large pieces in the interior.—*Hunt's (New York) Merchants' Magazine.*

HORSE-FLESH AS FOOD.

M. GEOFFROY SAINT-HILAIRE, Professor at the Museum of National History, has delivered two lectures on the advantages of bringing Horse-flesh into use for Food. There is no reason, he declares, why horse-flesh should not be eaten like the ox and the sheep; the horse is herbivorous, and no deleterious element enters into its food or structure. Its flesh, besides, is full of azote. The ancient Germans and Scandinavians had a marked liking for horse-flesh. They preserved a certain race of white horses to be sacrificed to Odin, and after the sacrifice they boiled the flesh and feasted on it. Thê introduction of Christianity put an end to this custom, and probably led to the aversion to horse-flesh, which is now generally manifested in Europe. The nomade tribes of Northern Asia make horse-flesh their favourite food, though they have numerous flocks of oxen and sheep. In spite of the dislike of horse-flesh in modern Europe, the Danes have recommenced the use of it. During the siege of Copenhagen in 1807, the Government formally authorized the sale of it in butchers' shops, and since then it has been constantly sold; there is even in that city a privileged slaughter-house for horses placed under the surveillance of the Veterinary School, and horse-flesh is sold in it at the average price of 12c. per lb. Parent Duchâtel, an esteemed writer, asserts that large quantities of horse-flesh were formerly introduced into Paris on different pretexts. Huzard, an eminent veterinary surgeon, states that in the scarcity which followed the Revolution of 1789, the greater part of the meat consumed at Paris for six months was horse-flesh, and that it caused no ill effect on the public health. The distinguished army surgeon, Baron Larrey, made his wounded patients eat horse-flesh in the campaigns of the Rhine, of Catalonia, and of the Maritime Alps, and he ascribes to it the cure of a great number of his sick in Egypt. From all these facts and nume-

rous others, M. Geoffroy Saint-Hilaire insists that the horse, in addition to the services which it already renders to man, can be made to supply cheap and nutritious food.

FUNCTION OF SALT IN AGRICULTURE.

MR. A. BEAUCHAMP NORTHCOTE has communicated to the *Philosophical Magazine*, No. 65, a paper of experiments undertaken to ascertain the *rationale* of the action of Salt in increasing the fertility of certain lands. We have not space for details, but quote Mr. Northcote's conclusions :—"The results, then, at which we must arrive are, that agricultural salt is a most energetic absorbent of ammonia, both in virtue of its chloride of sodium and of its soluble lime-salt, and that the proportion of the latter especially most powerfully affects its action ; but that at the same time its agency does not seem to be altogether a permanent one : it will collect the ammonia, but it is questionable whether it can retain it for any great length of time, because in the very decompositions which happen in order to render the ammonia more stable, salts are formed which have a direct tendency to liberate ammonia from its more fixed combinations. It may, however, retain it quite long enough for agricultural purposes : if the young plants are there ready to receive it, its state of gradual liberation may be for them the most advantageous possible ; and to this conclusion all experiments on the large scale appear most obviously to tend. It is described as an excellent check to the too forcing power of guano ; and from M. Barral's experiment we see that it either prevents the too rapid eremacausis of the latter, or stores up the ammonia as it is formed. As a manure for growing crops, all experience and all theoretical considerations therefore show it to be most valuable ; but when employed to mix with manure heaps which have to stand for considerable periods of time, theory would pronounce, as practice has in many cases done, that its power of retaining ammonia under those circumstances is at the best doubtful."

VALUE OF STEAM IN THE DECOMPOSITION OF NEUTRAL FATTY BODIES.

MR. G. WILSON, F.R.S., in the course of a long series of experiments conducted on a large scale, has observed that the so-called Neutral Fatty Bodies may be resolved, without danger of injurious decomposition, into glycerine and fatty acids, provided the still is maintained at a uniform high temperature, and that a continuous current of steam is admitted into it.

The temperature required to effect the splitting of the fats into their proximate elements varies with the nature of the body itself; but all hitherto tried may be resolved into glycerine and fatty acid at a temperature of 560° Fahr., many at much below that temperature.—*Proceedings of the Royal Society.*

NEW PROCESS OF OBTAINING AND PURIFYING GLYCERINE.

MR. G. FERGUSSON WILSON, F.R.S. (of Price's Patent Candle Company), has read to the British Association a paper describing the com-

pany's new process of Obtaining and Purifying Glycerine, preceded by a sketch of the history of glycerine and its uses; which we abridge.

"Glycerine," says Mr. Wilson, "was discovered in 1789, by Scheele, as a product in the process of lead plaister making, and was called by him the sweet principle of oils. About twenty-five years afterwards it was studied by Chevreul, and shown by him to be the base of fats and fat oils. A source of impure glycerine has long existed in the preparation of lead plaister, in which the combination of the litharge with the acids of the olive oil sets the glycerine free; another source in soap-making, the soda or potash setting free the glycerine; and a third source in the stearic candle manufacture, where the lime saponification separates the glycerine. Most of the purifiers of glycerine appear to have preferred this last source.

"Notwithstanding the known existence of these great sources of impure glycerine, it was long before glycerine was in any way utilized: hundreds of tons have been and are yearly thrown away."

Mr. Wilson then records Mr. Thomas De la Rue's application of glycerine to a burn, in 1844; Mr. Warrington's patent for its use in preserving animal and vegetable substances; and his successful application of it in mounting objects for the microscope. Mr. Wakley's application of glycerine, as a cure for deafness, dates from June, 1849; but M. Cap was the first to see its extraordinary value in a great variety of medicinal preparations.—*Journal de Pharmacie et de Chimie*, Feb. 1854; *Chemist*, April, 1855.

In the *Chemist*, of February, 1855, Dr. Crawcour, of New Orleans, stated that for twelve months past he had been in the habit of using glycerine very extensively in those cases requiring cod-liver oil, in which the nauseous taste of the latter medicine rendered its exhibition impossible; and that now, in his practice, it had entirely superseded cod-liver oil.

In a paper read at the meeting of the Royal Institution of 30th March, 1855, by the Rev. John Barlow, F.R.S., attention was drawn to the great preservative power of glycerine upon meat.

M. Cap worked upon the waste liquors of soap and stearic candle works, which liquors he had first to concentrate. His process was shortly this:—he used sulphuric acid to separate the lime, and continued boiling and agitation to drive off the volatile fat acids, removing any excess of sulphuric acid by means of carbonate of lime; allowing the liquor to cool at different densities, so as to deposit sulphate of lime; and, after final concentration, treating and filtering with washed animal charcoal. M. Cap's process, though an undoubted improvement, was not perfect, as glycerine so purified is always liable to contain more or less of salts of lime.

Mr. Wilson then describes this new process, in which the only chemical agents employed for decomposing the neutral fat, and separating its glycerine, are steam and heat; and the only agents used in purifying the glycerine thus obtained are heat and steam: thus all trouble from earthy salts or lead is escaped.

Steam, at a temperature of from 550° to 600° Fahr., is introduced into a distillatory apparatus, containing a quantity of palm oil. The

fatty acids take up their equivalents of water, and the glycerine takes up its equivalent; they then distil over together. In the receiver the condensed glycerine, from its higher specific gravity, sinks below the fat acids.

In an ordinary apparatus the glycerine distilled from the neutral fat is not in a sufficiently concentrated state for most purposes: it should therefore be concentrated, and, if discoloured, be redistilled. It is then obtained, at the temperature of 60° Fahr.: it is of sp. gr. 1·240, and contains 94 per cent. of anhydrous glycerine. It can be concentrated to s. g. 1·260, or to contain 98 per cent.

Mr. Wilson then mentioned some uses for glycerine which he believed to be new. A possible use which appears worthy of experiment is to inject it into the bladder for the purpose of dissolving calculous deposits: from its blandness it should not cause irritation, while, as it is a solvent of urea and phosphate of lime, it might dissolve them when in the bladder.

The properties of soothing and keeping moist the skin have caused it to be used upon chapped hands and sun-burnt faces. It has been suggested as a substitute for syrup in preserving fruits. Mixed with alcohol or peroxylic spirit, it has been proposed by Mr. Warren De la Rue as an economical fuel for spirit lamps.

For some time past, in Edinburgh as in London, it has been used in skin diseases; it is now being tried in some cases of disease of the mucous membrane of the stomach.

In the preparation of several medicines, glycerine may be substituted for syrup or sugar, with the effect not only of preserving the medicine in an active state and free from change, but also of very greatly improving its taste. Griffiths's iron mixture has been mentioned as an instance of this.

Glycerine appears to give the means of preservation of some objects of natural history without change in their colour. Mr. Wilson's first experiment was upon a brilliantly-coloured two pound trout, caught in one of the Perthshire lochs. Immediately on taking it from the water, he poured a quantity of glycerine over it, and wrapped it in a cloth. At night the fish was cleaned and immersed in glycerine. Next day it was again wrapped in a saturated cloth. On examining it a day or two afterwards in Edinburgh, the colour on the scales was unchanged. When it arrived in London, part was steeped in water and then cooked. Though perfectly fresh and firm, it had lost almost all its flavour; the uncooked portion was immersed in glycerine, and sent to Professor Owen, who suggested that the brilliantly-tinted fishes of the Coral Islands and tropical coasts might be brought home in kegs of glycerine.

In conclusion, though a variety of uses, actual and possible, for pure glycerine have been mentioned, yet when we consider its power as a solvent, and at the same time its blandness, and freedom from all irritant, exciting, acid, and fermenting properties, we must feel that not a tithe of its uses have yet been developed.

GELATINE PAPER.

Mr. Horace Dobell has made to the Royal Society a communication "On the Applicability of Gelatine Paper as a Medium for Colouring Light." The object of this communication is threefold.

1. To point out the properties of a material called gelatine paper, which render it applicable as a medium for colouring light.

2. Through the means of gelatine paper, to introduce the use of coloured light in the arts for the preservation of the sight of artisans.

3. To introduce the use of gelatine paper for the relief of persons suffering from impaired vision; for the preservation of the sight of travellers, and of all those who are much engaged in reading.

This material was invented in 1829 by the late M. Grenet, of Rouen, and was exhibited by him in its present state of perfection at the Great Exhibition of 1851. But up to the present time it has not been successfully applied to any more useful purposes than the manufacture of artificial flowers, address-cards, tracing-paper, wafers, &c.

It is commonly manufactured in sheets, measuring twenty-two inches in length and sixteen inches in diameter, which are sold at a small price; but the sheets can as easily be made of any dimensions not exceeding those of which plate-glass is capable. It can be made of any thickness, from that of the finest tissue paper upwards. It may be obtained as transparent as the best glass, and more free from colour, or of all colours and shades of colour, without interfering with its transparency. It is exceedingly light, and may be bent or rolled up without injury. It can be cut with scissors like ordinary paper, and may easily be stitched with a needle and thread. By means of an aqueous solution of gelatine, it can be made to adhere accurately to plates of glass without any interference with its transparency. When varnished with collodion it becomes waterproof, more pliable, capable of bearing heat without injury, and its transparency is not affected.

Hence it appears, that, in addition to its transparency and susceptibility to various colours and forms, gelatine paper is cheap, portable, and durable.

Such being the properties of the material, the following are enumerated by the author as some of the forms in which he suggests that it may be employed, and in which it has already been found useful:—

1. A small sheet of very pale green or blue gelatine paper, to be used in reading. The sheet is simply to be laid upon the page of the book, and the reading to be conducted through the coloured medium. If used in a faint light, the reading paper is to be raised a little from the book to admit more light beneath it.

2. A sheet of gelatine paper of pale green set in a light frame, and placed like a screen before the window or lamp of the engraver, the watchmaker, the jeweller, and the like; thus providing a light of genial colour, in which they may pursue their occupations.

3. A similar appliance to the last mentioned, for the use of needlewomen. For this purpose screens are to be provided, both of green and of blue gelatine paper; so that the white materials employed in needlework may be changed to a pleasant green, by the screen of that colour,

the yellow materials to a green by the blue screen, and by one or other of these screens the reds softened down into violets or browns.

4. For either of the two last purposes on a larger scale, the gelatine paper may be attached to the window glass of the apartment, thus colouring, if necessary, all the light admitted during daylight.

5. Shades for the eyes in certain affections of the sight, to take the place of the green or blue silk, and card shades worn by many persons. The gelatine paper being transparent, will allow the wearer to see his way about, at the same time that the eyes are protected from a glaring light. This may be especially useful in cases where it is desired not only to shade a diseased eye, but also to protect its nerves from strong light admitted by the sound eye. When not only coloured light but a certain degree of darkness is required, this can be readily and delicately graduated by employing shades of different depths of colour.

6. Masks of gelatine paper for protecting the eyes of travellers against the glare of snow-fields and of sandy deserts.

MANUFACTURE OF CINNABAR AT IDRIA.

M. Huyot commences the process with the preparation of the black sulphuret of mercury. For this purpose 42 lb. of mercury and 8 lb. of sulphur in coarse powder are introduced into a cask, which receives by machinery a reciprocating rotatory movement at the rate of from 15 to 25 rotations per minute. The length of time during which the mixture remains in the casks varies from 2·3 to 3·5 hours, according to the temperature. The combination of the materials is not complete, for particles of sulphur and globules of mercury may still be detected on it, and here and there it acquires a reddish tint from incipient conversion into cinnabar. The mass is then introduced into cast-iron retorts, of which there are 24 arranged in four furnaces. Each retort is furnished with an earthenware head connected by a tube with a receiver. The heads being adjusted and properly luted, heat is applied, and the temperature raised to 259°. As soon as sulphureous vapours appear, the tube and receiver are attached, and at the temperature of 716° sublimation goes on with rapidity. The retorts require about two-and-a-half hours to reach the temperature at which sublimation commences, and the charge is sublimed in about five hours. Of every 1000 parts of sublimed cinnabar, 365 are found in the part of the head next the retort, 327 in that nearest the tube, 255 in the tube itself, and 53 in the receiver. The cinnabar is then ground by passing it between stones placed at different distances apart, according to the fineness of the grain required. Chinese cinnabar is ground twice, dark red four times, and bright red cinnabar five times.

The product is then refined, as it is called, in order to remove the excess of sulphur employed in the first process. For this purpose it is digested with a ley of wood ashes concentrated until it has a density of 12 B. The cinnabar is then repeatedly washed, and dried on iron plates.—*Polytechnisches Centralblatt*, 1855.

COLOURING MATTER OF ROTTLERA TINCTORIA.

Professor Anderson, M.D., of the University of Glasgow, states, in

the *Edinburgh New Philosophical Journal*, No. 2:—The colouring matter of the Rottlera Tinctoria (a large tree, widely distributed over the Indian peninsula) has long been an article of commerce in India, and is still farmed by Government, being in considerable demand among the Mahommedan population for dyeing silk. No attempts have as yet been made to introduce it into European commerce, an impression appearing to have existed that the supply is too limited to make it of importance. Dr. Cleghorn, of Madras, assures the author that this impression is unfounded, and that very considerable quantities might be obtained, if it were likely to prove useful; and the trials Dr. A. has made with it are sufficient to show that it really merits the attention of silk-dyers. Of its chemical composition very little is known, the only person who has yet examined it being Solly; and even he appears to have done no more than substantiate the fact that the colouring matter is extracted by alcohol, and has the character of a resin.

Professor Anderson then gives the analysis of the specimen of the matter which he has received from Dr. Cleghorn, and concludes as follows:—

The colouring matter of the Rottlera belongs to the class of substantive dyes. It does not require a mordant, all that is necessary being to mix it with water, containing a solution from a fourth to a half its weight of carbonate of soda, and to boil it with the stuff. The Hindoos, in addition to carbonate of soda, which they use in the form of native barilla, employ powdered gum, and before adding water, rub the whole of the materials up with a small quantity of sesamum oil. These additions, however, are not necessary for success, as I obtained a very fine colour without them. It is remarkable, however, that this colour is only produced on silk. Calico, whether with or without a mordant, acquires only a pale fawn colour, and entirely devoid of beauty. On silk, the colour is a rich flame or orange tint, of great beauty and extreme stability. The great brilliancy and permanence of the tint which it produces, and the fact that the material supplied by commerce contains between 70 and 80 per cent. of real colouring matter, ought to induce the silk-dyers of this country to turn their attention to it, the more especially as there is no doubt that if the matter were placed in the hands of an intelligent person, our Indian empire might supply it in abundance.

ORGANIC COMPOUNDS CONTAINING METALS.

MR. FRANKLAN has described to the British Association some new Compounds which he has obtained, and particularly one prepared by the action of nitric oxide on zinc ethyl, which may be regarded as an ammonium in which one atom of hydrogen is replaced by zinc, another by ethyl, and the remaining two by oxygen.

EXTRACTION OF METALS FROM THE ORE OF PLATINUM.

M. FRÉMY, in a paper read to the British Association, treats of the preparation of osmium, rhodium, and iridium from the residues of the Platinum Ores. The preparation of osmium, according to the old method, is attended with great difficulties and actual danger. M. Frémy

proposes to prepare osmium by passing atmospheric air over the residual ore, heated in a porcelain tube. The volatile osmic acid is condensed in glass balloons, and the less volatile oxide of ruthenium is found at the extremity of the heated tube. The rhodium remaining in the residual mass is separated from the other metal contained by chlorine gas at a high temperature.

SUPPOSED INFLUENCE OF THE HOT-BLAST IN AUGMENTING THE QUANTITY OF PHOSPHORUS IN PIG-IRON.

MESSRS. PRICE and NICHOLSON have communicated to the *Philosophical Magazine*, No. 68, a paper on this inquiry. The employment of the hot-blast in the smelting of iron is admitted to occasion the production of pig-iron of inferior quality: that is to say, contaminated with larger amounts of foreign elements than that smelted with cold-blast.

In the present communication the authors limit their remarks to the consideration of the supposed influence of hot-blast in augmenting the quantity of phosphorus, an element of almost constant occurrence in pig-iron, and to the presence of which in bar-iron the peculiar property of the metal known as *cold shortness* is attributed.

We have only space for the authors' brief recapitulation of the results of their experiments.

1st. That in assaying ores, all the phosphorus of the phosphates will be found in the button.

2nd. That when the ordinary iron ores, such as the argillaceous ores, black bands, hæmatites, &c., are smelted, the iron produced, if it be grey, will contain all the phosphorus of the ore, whether the furnace be driven with hot or cold blast.

Lastly. That the slag may contain phosphoric acid in determinable quantity when white iron is being smelted.

PLATING METALS WITH TIN, NICKEL, AND ALUMINA.

A PATENT has been obtained by Mr. Thomas, of Fulham, and Mr. Tilley, of Holborn, for an improved process for Plating or Coating Lead, Iron, or other metals with Tin, Nickel, or Alumina, of which the following is the specification:—

"The first part of our process," say the inventors, "consists in a mode of preparing a solution of the metal with which the articles are to be coated or plated, for which purpose we proceed as follows:—For tin we dissolve metallic tin by nitro-muriatic acid, and then precipitate the tin by an alkali or alkaline salt, preferably by the ferro-cyanide of potassium; we then mix sulphuric acid or muriatic acid with the precipitated oxide of tin, to which we add a portion of water; these we boil in an iron vessel with a small portion of ferro-cyanide of potassium, then filter the liquor, and the solution is completed.

"Another mode of forming a solution of tin is as follows:—Having precipitated the oxide of tin, as above described, we add ferro-cyanide of potassium to the oxide and boil them; then set the solution aside to cool, and then filter the same; we then pass a stream of sulphuric acid gas through the solution.

"For nickel, we dissolve nickel by nitro-muriatic acid, and precipitate the oxide by ferro-cyanide of potassium; we then wash the oxide and add thereto cyanide of potassium dissolved in distilled water; then boil the mixture, and when cool filter the same, which completes the solution of nickel.

"For alumina, we dissolve alum in water and add ammonia until it ceases to precipitate any more; we then wash the alumina, filter it, add thereto distilled water; boil the same with cyanide of potassium, filter when cold, and the solution of alumina is ready.

"Having thus obtained either of the foregoing solutions, the articles to be covered or plated are suspended by copper or brass rods in a bath of the required solution and attached to the zinc pole of a battery, to the positive pole of which is attached, in the case of a tin bath, a piece of platinum, or a pole of tin in the case of a nickel bath, a bag containing oxide of nickel, or a pole of nickel, and in the case of a bath of alumina, a bag of alumina, or a pole of alumina, or a piece of platinum."—*Mechanics' Magazine*, No. 1665.

NEW ORE OF SILVER.

Some years since, Mr. J. H. Brooke received from Mexico a specimen of an Ore of Silver, said to be carbonate. It occurs in small, compact, irregular-shaped, earthy-looking masses, imbedded in carbonate of lime and quartz, accompanied by crystallized blue carbonate of copper. Its colour is dull, dark gray; it is entirely devoid of lustre, and its hardness appears to differ in different parts of the specimen.

It was examined in a very cursory manner by the late Richard Phillips; and the portion he examined being found to effervesce with acid and to contain silver, he was led to regard it as a carbonate, and particularly as it so much resembled the carbonate of silver described by Selb.

A recent examination of it, however, by Mr. Richard Smith, in the metallurgical laboratory at the Museum of Practical Geology in Jermyn-street, shows it to be a very different compound, and one new to mineralogy; and there can be no doubt that the carbonic acid which deceived Mr. Phillips was derived from the intermixed carbonates of lime and of copper.

The analysis of two small portions of the earthy part of the substance, separated from the matrix, gave the following results per cent.:—

	I.		II.
	a.	*b.*	
Silver	16·09		17·18
Antimony	7·82	7·50	7·28
Sulphur	1·41		1·84
Selenium	2·81		3·58
Chloride of silver	1·26		2·67
Oxide of copper	10·46		8·61
Silica	45·56		41·81
Alumina	2·06		4·04
Peroxide of iron	2·21		
Lime	1·72		2·83
Carbonic acid	2·92	3·04	
Combined water	2·31		
Hygroscopic water	·99		
	97·61		

The whole of the copper contained in the mineral is dissolved out by acetic acid; from this we may infer that it is not present in the form of sulphide or selenide. The acetic acid solution was found to contain lime, but did not give any precipitate with the addition of hydrochloric acid, nitrate of silver, or chloride of barium.—*Philosophical Magazine*, No. 68.

THE MORAYSHIRE SLAG.

MR. W. RHIND has communicated to the Royal Physical Society of Edinburgh, the details "Of some Circular Mounds, covered with a Metallic Slag, which occur on the Sloping Sides of the Gneiss Hills, Parish of Birnie, Morayshire."

Several deposits of this metallic matter occur in circular, somewhat elevated mounds, about four feet in diameter, lying upon the moss-soil of the moors, both in this locality and in some of the moorland slopes of the country to the westward, the vague traditions of the county being that they are the remains of iron-works, used by the armies that had in former times passed over the country. A discussion ensued, in which Professor Fleming, Mr. Alexander Rose, and others, took part, on the probable cause of the formation of this metallic matter,—whether it was accumulated by fires occurring in the moors, or by solution, and subsequent deposition from water. Similar slags were exhibited by Professor Fleming, from Maryculter, Aberdeenshire.

Dr. Heddle, the author, stated that the extreme brittleness of this substance, the number of vesicular cavities, the pavonine lustre of its fracture, and the separation of minute specks of *metallic* iron, show that it is indubitably a *slag*. In the qualitative analysis, he has obtained silica, alumina, lime, oxides of iron and manganese, magnesia, potash, soda, and a trace of phosphoric acid. The quantity of silica is 24·045, of alumina 14·410, of lime 2·184; the proportions of magnesia, potash, and soda being small, he did not determine, and the large excess obtained in the analysis, when the iron was calculated as *peroxide*, shows that a considerable portion of it (about one-third) must have been present in the metallic state; the total quantity calculated as *metal* is 52·370; the manganese he did not separate from the iron, because the quantity was small, and could not in any way affect the decision that the substance was a slag.

Upon the whole, the opinion of Dr. Fleming, as previously stated, seemed to be established, that the substance in question is neither an ore of manganese nor a bog iron ore, but a slag arising from the burning of a bed of peat during a dry season, melting a ferruginous soil.

FORMATION OF BRASS BY GALVANIC AGENCY.

COPPER is more electro-negative than zinc, and separates more easily from its solutions than a metal less negative. If then, in order to obtain a deposit of brass by Galvanic means, we employ a solution containing the two component metals, copper and zinc, in the proportions in which they would form brass, there will only be produced by the action of the battery a deposit of real copper; the zinc, more difficult of reduction, remains in solution. What must be done, then, to obtain

a simultaneous precipitate of the two metals in the proportions required, is either to retard the precipitation of the copper, or to accelerate that of the zinc. This may be effected by forming the bath with a great excess of zinc and very little copper.

Dr. Heeren gives the following proportions as having perfectly succeeded :—

There are to be taken of	
Sulphate of copper	1 part.
Warm water	4 ,,
And then	
Sulphate of zinc	8 ,,
Warm water	16 ,,
Cyanide of potassium	18 ,,
Warm water	36 ,,

Each salt is dissolved in its prescribed quantity of water, and the solutions are then mixed; thereupon a precipitate is thrown down, which is either dissolved by agitation alone, or by the addition of a little cyanide of potassium; indeed, it does not much matter if the solution be a little troubled. After the addition of 250 parts of distilled water, it is subjected to the action of two Bunsen elements charged with concentrated nitric acid mixed with one-tenth of oil of vitriol. The bath is to be heated to ebullition, and is introduced into a glass with a foot, in which the two electrodes are plunged. The object to be covered is suspended from the positive pole, whilst a plate of brass is attached to the negative pole. The two metallic pieces may be placed very near.

The deposit is rapidly formed if the bath be very hot; after a few minutes there is produced a layer of brass, the thickness of which augments rapidly.

Deposits of brass have been obtained in this way on copper, zinc, brass, and Britannia metal; these metals were previously well pickled. Iron may, probably, also be coated in this way; but cast-iron is but ill-adapted for this operation.—*Mittheilungen des Hannov. Gewerbe-vereinsi Dublin Journal of Industrial Progress.*

PREPARATION AND PROPERTIES OF ALUMINIUM.

SOME time since it was announced that Deville* had succeeded in procuring aluminium in abundance, and by a process which would permit its use in the arts. It now appears that the processes employed by Deville are merely modifications of those already known, sodium and the galvanic battery being the agents employed to reduce the chloride of aluminium. These processes are manifestly so expensive as to render it unlikely that aluminium will be applied to any economic uses, but the author has been enabled to describe more fully than has before been done the properties of the metal. It is a fine white metal, with a high metallic lustre. Its hardness, when cast, is about the same as that of pure silver, but is increased by pressure. It is highly malleable and ductile, conducts electricity about eight times as well as

* See the account of M. Deville's discovery, by M. Dumas, in the *Year-book of Facts*, 1855, p. 171. In the United States, Aluminium is called the New French silver.

iron, and is slightly magnetic. It crystallizes readily by fusion, and its crystals appear to belong to the regular system. It melts at a temperature above that of zinc, but lower than silver, and the author attributes the excessively high melting point found by Wohler to the presence of platinum in the specimen examined by him. Its sp. gr. is 2·56, which is increased to 2·67 by rolling. It is unaltered by air and oxygen, even at the melting point of gold. It is without action in water, at ordinary temperatures, at 212°, and even at a lower heat; but at a high temperature, it slowly decomposes it. Nitric acid, at common temperatures, does not attack it, and even when boiling, the action is excessively slow; nor is it soluble in diluted sulphuric acid. Its true solvent is hydrochloric acid, which attacks it very rapidly. At a very low temperature the gas attacks it, and converts it entirely into the chloride. Sulphuretted hydrogen is without action upon it. Aluminium does not amalgamate with mercury, but alloys with copper, silver, and iron. It gives a compound with carbon.—*Annales de Chim. et de Physique*, vol. xliii.

The following observations, from the correspondence of M. Jerome Nicklès, of Paris, have appeared in the *American Journal of Science.*

At the Chemical Works of Javel it has been proved that *sodium*, which is superior in energy to *potassium*, may be prepared by Deville's process. Numerous trials have also shown that it may be kept in fusion in contact with the air without inflaming; and that it may be run out of the apparatus which furnishes it. A metal like *sodium* brought within the reach of science and the arts, must soon come into extensive use. M. Dumas has remarked on the fact, that the study of aluminium had introduced a new process into the arts for the reduction of ores—that from the chloride of the metal; and that this method might be important for other metals not yet brought into use. He also mentions the sonorousness of aluminium, a quality in which it compares with the best bronze, having a quality of tone not hitherto observed in any metal in the pure state, which is another peculiarity of this curious metal. He stated in reply to inquiries, that the materials employed in making one kilogram of aluminium, viz., the ammoniacal alum, the alumina which is derived from it, chlorine, carbon, carbonate of soda, chalk, are all of low price. The whole cost is reduced to thirty-two francs, which is very small when we consider that the expense of sodium, when the experiments in aluminium were begun, was 1000 francs per kilogram, which alone would make the price of aluminium 3000 francs. M. Balard, who is familiar with industrial applications, stated that he had gone through the steps of the process at Javel, and was satisfied that the cost of the sodium could be still further reduced when prepared on a larger scale, which I hope some of your readers will speedily attempt.

The chloride of aluminium is prepared at the Javel Works by the reaction of chloride on a mixture of alumina and coal tar previously calcined, which is easily effected in a gas retort. The condensation of the chloride is produced in a chamber of masonry, lined with earthenware. The chloride contains a little iron, which is removed entirely in melting it for aluminium, by making its vapour pass over points of

iron heated to 400° C. The sesquichloride of iron, as volatile as the chloride of aluminium, is changed, through contact with iron, into the protochloride, which is relatively very fixed. The vapour of the chloride of aluminium, in leaving the apparatus; affords colourless transparent crystals.

In preparing the sodium there are used—

Dry carbonate of soda	1000 parts.
Chalk	150 „
Dry coal of Charleroi	450 „

which are pulverized, mixed with care, and calcined to a red heat in a pot.

Wheatstone long since showed that aluminium was as strongly negative as platinum. M. Hulot, director of the galvanizing and coinage of Paris, has tried the use of the impure aluminium in a galvano-plastic battery. He found that a couple of aluminium and zinc, the latter amalgamated some considerable time previously, when charged with water, acidulated with $\frac{1}{20}$th of sulphuric acid at 66° C. has afforded during the first hour a current at least equal to that from a couple of platinum and zinc excited to the same degree. After six hours the current had lost one-fifth of its original force. The battery was not completely polarized at the end of twenty-four hours, and the current still preserved one-fourth of its force. To restore its electro-negative character to the aluminium, it was necessary only to immerse it an instant in nitric acid, and then wash it.

According to MM. Tissiers, pure aluminium is easily distinguished from the impure, by its greater whiteness, its indistinct traces of crystallization, and rarely one or two well-defined hexagons on the surface of the ingots; while the impure has a bluish tint, like zinc, and if the whole is not crystalline, the upper surface is much more so than in pure aluminium, and the form is also quite different. According to the experience of one of the most extensive galvanizing establishments of Paris, the metal works as well as silver.

It may be whitened easily by dipping the piece in a concentrated solution of soda or potash, and passing it then into nitric acid. This acid acts differently according as it is itself pure or mixed with chlorhydric acid, and according as the aluminium is pure or not.

Aluminium is most easily soldered when alloys are used containing aluminium. The alloys most convenient are those with silver, zinc, or tin; the point of fusion being below that of aluminium; the soldering may be done by means of a simple spirit lamp, and without any previous cleaning.—*Correspondent of the Mechanics' Magazine*, No. 1683.

M. Raby writes from the Paris Exhibition, August 22nd:—"My famous pocket chronometer, made out of the precious aluminium, has been placed in the Panorama, alongside of the bars of the same metal; it keeps time very correctly. All the works, plates, cogs, and wheels, are made of aluminium; and I really believe it is much better for purposes of this kind than the other metals generally employed. It is much lighter, does not require so much power to conduct the wheels, and therefore, with a heavy balance, will obtain a better result

of regularity. It is very hard and smooth when hammered, and the friction will be reduced to almost nothing."—*Mining Journal.*

At the late Meeting of the British Association, Dr. Daubeny laid on the table some fine weights made of aluminium; they were intended for use in chemical experiments.

In the *Philosophical Magazine*, No. 66, is a translation of a paper of H. Rose, of Berlin, describing a method of preparing aluminium from kryolite; and in No. 67 is detailed the preparation from the same substance, by Mr. Allan Dick.

Among the many remarkable qualities of aluminium, such as its resistance to oxidation, either in the air or by acids, its hardness, its wonderful lightness, its malleableness, the facility of moulding it, &c., Mr. Dumas mentions another, its sonority. An ingot was suspended by a string, and being lightly struck, emitted the finest tones, such as are obtained only by a combination of the best metal.

NEW METEORIC IRON, FROM CHILI.

Mr. R. P. Grey has communicated to the *Philosophical Magazine*, No. 63, the analysis of a mass of Meteoric Iron, found on the desert of Tarapaca. In general composition, it closely resembles the majority of meteoric irons hitherto analysed; but, on cutting the iron into slices, it was found to be honeycombed with cavities, some of which actually contained what appeared to be pure *lead!* In some the lead was not larger than a pellet, and did not fill the entire cavity which contained it; in others the entire cavity was filled with lead, in size equal to a pea. Dr. Heddle examined some of it, and found it to be chemically pure lead; when the tarnished surface was not scraped off, small quantities of iron and alumina, and mere traces of phosphorus and magnesia, were found.

This is the first authentic instance of the existence of lead in meteoric bodies, and to find it so closely allied with, and buried, as it were, in metallic iron, is not only in itself singular, but difficult to account for. It is, however, probable that the lead was originally held in alloy along with the nickel and cobalt, and on intense heating or partial fusion of the iron mass, "sweated" out into vesicular cavities.

Should this be a correct view, it is a proof of the intense heat to which iron meteoric masses appear to have been subjected at the time of, if not previous to, their reaching the surface of the earth. Indeed, meteoric *stones* seem to have been subjected to a much smaller degree of heat while falling than *iron* masses, if we may judge by appearances—the only sign of fusion in *stones* being quite external, and merely marked by a thin, black, and shining crust.

Iron falls are extremely rare compared with what are called *stone* falls; so much so, indeed, that there are not more than three or four authentic accounts of the fall of *iron* masses, and these not large ones, bearing no comparison to the enormous masses weighing from 5 to 20 tons, which have been occasionally found on the plains of Mexico and South America.—See *Philosophical Magazine*, No. 54.

SUPPOSED AEROLITE.

Sir Roderick Murchison has communicated to the Royal Society a paper "On a Supposed Aërolite or a Meteorite found in the trunk of an old Willow-tree in Battersea-fields." Among the evidence collected by the author on the spot, was that of a market-gardener, who had long resided there. He had observed that the tree was blighted in one of its main branches for many years, and had always supposed that it was struck by lightning in one of two storms, the first of which happened about 1838 or 1839, the other about nine years ago.

So far the evidence obtained might be supposed to favour the theory that this ferruginous mass (supposed to weigh about 30 lb.) had been discharged near to the blighted branch, and had penetrated downwards into the tree, to the position in which we now see it, charring and warping the wood immediately around it in its downward progress; whilst in the sixteen years which have elapsed, the wood renovating itself, produced an appearance which has much interested the eminent botanists who have examined it—viz., Mr. R. Brown, Dr. Lindley, Professor Henfrey, Dr. J. Hooker, and Mr. Bennett.

Sir Roderick then points out some features of this extraordinary case, which check the belief in the included mass being a meteorite. He found lying near the root of the tree two fragments, one of which is similar to the substance included in the tree, while the other is decidedly an iron slag. On bringing these fragments, weighing several pounds, to Jermyn-street, and on breaking one of them, it was found, like the supposed meteorite, to contain certain small portions of metallic iron, in which both nickel and cobalt were also present; and hence the scepticism which had prevailed from the beginning of the inquiry in the minds of some friends, was worked up into a definite shape.

Dr. Percy (of the Museum of Practical Geology) has analysed a portion of the mass; and the following are his results:—

"*The slag-like matter* (1) attached to the metal in the tree, as well as the similar matter (2) with adherent metal which was found by Mr. Reeks in the vicinity of the tree, has been analysed. The results are as follow:—

	No. 1.	No. 2.
Silica	58·70	63·52
Protoxide of iron	35·46	32·30
Lime	0·30	0·59
Magnesia	0·74	0·21
Protoxide of manganese	trace	trace
Alumina	3·40	2·85
Phosphoric acid	0·43	0·57
Sulphur as sulphide	trace	trace
	99·03	100·04

"No. 1 was analysed by Mr. Spiller, and No. 2 by Mr. A. Dick, chemists who have been incessantly engaged at the Museum during the last two years and a half in the analyses of the iron ores of this country, and whose great experience renders their results worthy of entire confidence. Cobalt and nickel were not sought for in either case, but the metallic iron enveloped in both specimens contained a minute quantity of cobalt and nickel. Another piece of slag-like matter, which was found on the ground near the tree, and which, from its external characters I have no hesitation in pronouncing to be a slag, was examined for cobalt and nickel, and gave unequivocal evidence of the former in minute quantity, though not satisfactorily of the latter.

"The metal previously mentioned is malleable iron. That which was detached form the slag-like matter, found outside the tree, was filed and polished, and was

then treated with dilute sulphuric acid. After this treatment, the surface presented small, confused, irregularly-defined crystalline plates, and was identical in appearance with the surface of a piece of malleable iron similarly treated after fusion in a crucible."

These analyses lead to the conclusion, in part anticipated by Sir R. Murchison, well calculated, by his analytical researches, to settle the question on a permanent basis, "that the composition of this body is different from that of well-authenticated meteorites, and is similar to that of undoubted iron slags; we shall then have obtained proofs of the great circumspection required before we assign a meteoric origin to some of these crystalline iron masses, which, though not seen to fall, have, from their containing nickel, cobalt, and other elements, been supposed to be formed by causes extraneous to our planet."

(See the entire paper, which contains illustrative circumstances and evidence of a very interesting character.)

FALL OF METEORIC IRON.

MR. H. E. SYMONDS thus describes the fall of a large mass of Meteoric Iron, in January, 1844, in Carritas Pass, on the River Mocorita, in South America:—

The light that accompanied it was intense beyond description. It fell in an oblique direction, probably at an angle of about 60° with the earth, and its course was from east to west.

Its appearance was that of an oblongated sphere of fire, and its tract from the sky was marked by a fiery streak, gradually fading in proportion to the distance from the mass, but as intensely luminous as itself in its immediate vicinity. The noise that accompanied it, though unlike thunder, or anything else that I have heard, was unbroken, exceedingly loud and terrific. Its fall was accompanied by a most sensible movement of the atmosphere, which I thought at first repellent from the falling body, and afterwards it became something of a short whirlwind. At the same time I and my companions all agreed that we had experienced a violênt electric shock; but probably this sensation may have been but the effect on our drowsy senses of the indescribably intense light and noise. The spot where it fell was about one hundred yards from the extreme right of our division, and perhaps four hundred from the place where I had been sleeping. Accompanied by our general (Dr. Joaquin Madauaga), I went within ten or twelve yards from it, which was as near as its heat allowed us to approach.

The mass appeared to be considerably imbedded in the earth, which was so heated that it was quite bubbling around it. Its size above the earth was perhaps a cubic yard, and its shape was somewhat spherical; it was intensely ignited and radiantly light, and in this state it continued until early dawn, when the enemy, having brought his artillery to the pass, forced us to abandon it to continue our march. I may mention, that, at the time of its fall, the sky above us was beautifully clear, and the stars were perhaps more than usually bright; there had been sheet lightning the previous evening.

I never afterwards had an opportunity of revisiting the Mocorita, for our permanent encampment was thirty-five leagues to the north of that pass, between which and our encampment the country was entirely depopulated by our long war; but as the spot where the aërolite fell was known to many of our subaltern officers, who were frequently sent to observe the frontier of Entre Rios, I have heard them describe it as a *piedra de fiérro*, *i. e.* a stone of iron; and I once provided one of the most intelligent of them with a hammer in order that he might bring me a sample of it. On his return, he told me it was so excessively hard that the hammer bent, and was broken in unsuccessful attempts to break off a small piece of it.—*Philosophical Magazine*, No. 63.

THE UNIVERSAL THERMOMETER.

THIS instrument, originated by Charles Coddington Maugher, of

Jersey, made and sold by J. Newman, 122, Regent-street, London, by its sale brings no pecuniary benefit whatever to the inventor of it; nor had the maker, Mr. Newman, from its first introduction, any other motive than the wish to spread its use in the scientific world; and it is sold at the same prices as those with the old scale. Unless in the case of cold artificially produced, the new scale entirely dispenses with the use of the signs + and —: as zero represents the greatest supposed natural cold (Polar Winter), 100° the freezing point, and 300° the boiling point of water at the level of the sea.

VOLCANIC ACTION.

MR. JAMES NASYMTH, of Patricroft, in a letter to the *Athenæum*, No. 1439, observes that "the floods of molten lava which volcanoes eject are nothing less than remaining portions of what was once the condition of the entire globe when in the igneous state of its early physical history, no one knows how many years ago!

"When we behold the glow and feel the heat of molten lava, how vastly does it add to the interest of the sight when we consider that the heat we feel and the light we see are the residue of the once universal condition of our entire globe, on whose *cooled surface* we *now* live and have our being! But so it is; for if there be one great fact which geological research has established beyond all doubt, it is that we reside on the cooled surface of what was once a molten globe, and that all the phenomena which geology has brought to light can be most satisfactorily traced to the successive changes incidental to its gradual cooling and contraction. If this one grand principle be kept in mind, all the apparently complex and perplexing phenomena which the present condition of the earth's surface presents to our contemplation disappear, and the nature of those actions which have, through a vast succession of ages and changes, given to its crust its present character and aspect, becomes comparatively simple and understandable.

"And, as before said, when we behold a volcano belching forth its fiery floods, how vastly is the sublimity of the sight enhanced when we consider that in the molten lava we have before us a sample of the present condition of the interior of our globe, and also of what was the condition of its entire mass during the earliest days of its physical history!

"In former times, when geological research had made but little progress, volcanic action was ascribed to some adventitious union of substances, whose combination resulted in the development of intense heat and violent eruptive action. This notion as to the nature and cause of volcanic action has been long since abandoned by all those who have carefully studied the phenomena of all classes of volcanic action. Volcanic action depends on a great cosmical principle, and when rightly considered, is an expiring phenomenon—one whose vehemence in early periods of the earth's history was infinitely more tremendous, frequent, and extensive than it is now, and is destined by the lapse of time gradually to disappear as one of the active phenomena of nature.

"That the influx of the sea into the yet hot and molten interior of the globe may occasionally occur, and enhance and vary the violence of the

phenomenon of volcanic action, there can be little doubt; but the action of water in such cases is only *secondary*. But for the pre-existing high temperature of the interior of the earth, the influx of water would produce no such discharges of molten lava as generally characterize volcanic eruptions. Molten lava is, therefore, a true vestige of the Natural History of the Creation."

IMPROVED STEREOSCOPES.

M. Claudet, the well-known photographer of Regent-street, has patented this invention, which consists:—1. In giving a curvature to the interior of the outer casing of Stereoscopes, and in providing them with interior chambers, so as to greatly reduce the reflection which takes place in ordinary stereoscopes, and to shut out from the sight of the observer all extraneous objects. 2. In the adaptation of the lenses so as to obviate the necessity of any adjustment to suit observers whose eyes are at different distances apart. 3. In obtaining, by means of an index, the ready adjustment of the foci of the eye-pieces to the three usual varieties of sight. 4. In the application to stereoscopes of a revolving frame or frames carrying a series of slides, whether caused to revolve by hand, or by suitable machinery. 5. In shutting off the sight of the revolving frame while the pictures are being changed, by means of the rising and falling of a shutter. 6. In the use of central parts of whole lenses for the eye-pieces, thus avoiding the distortion of objects.

PROGRESS OF PHOTOGRAPHY.

Production of Daguerreotypes without Lenses.—Mr. J. F. Mascher, of Philadelphia, has communicated the following to the *Scientific American*:—

I send you with this two stereoscopic pictures, taken by me by means of a box, to be described hereafter, which contained neither lenses, reflectors, nor any refracting or reflecting medium of any kind.

I accidentally made the discovery that photographic pictures could be taken in this manner, while prosecuting some experiments relative to stereoscopic angles.

It is well known that two pictures, taken with two ordinary cameras, placed only 2½ inches apart horizontally, will not, when placed in the stereoscope, show proper or sufficient stereoscopic relief; and yet it is well known that the human eyes are only placed 2½ inches apart, and see solid objects in their proper solidity and relief. To explain the why and wherefore of these facts has challenged the attention of Professor Wheatstone, Sir David Brewster, and a host of others; leading the above-named gentlemen into a very sharp controversy, leaving the main question—the determination of the proper stereoscopic angles—as far as practical results are concerned, in precisely the same condition in which they found it.

Under the circumstances, we may be permitted to ask, why is it that two pictures, taken by two cameras placed 2½ inches apart, do not show sufficient stereoscopic relief? Why is it that we must place the cameras about eight times further apart than the human eyes, in order to produce the proper relief? When these questions first suggested themselves, the following answer occurred to me (without, at that time, being able to prove it to be the correct one), namely, "Because the lenses in the camera (quarter size) are twelve times larger than the human lenses (eyes)."

In order to ascertain whether this was the correct answer or not, it was only necessary to take two pictures with two cameras, having a diaphragm in each, the openings of which were one-eighth of an inch in diameter, that being the diameter of the diaphragm of the human eye. In executing this experiment, I

was very much surprised to find that the focal range of the camera was increased to an extraordinary extent. The cameras had been focussed for a house on the opposite side of the street; but the moment the diaphragm was introduced, the sash in the window, which before was invisible, suddenly became as sharp and distinct as the house on which the focus had been previously drawn. Subsequently, on removing the camera to an upper story of my house, it was found that this increase in focal range extended not only from the house towards the camera, but also to an equal extend beyond the house. After ascertaining these facts, it became desirable to find out the causes of them. With this end in view, the lenses were removed from the tube, and only the diaphragm remained in it. You may well imagine my astonishment at finding the pictures of houses and other objects in the street faithfully depicted upon the ground glass! The letters of signs, &c., were reversed precisely as if lenses had been used. The next step was to ascertain whether these pictures possessed photogenic properties, which was soon done by substituting a metal diaphragm with an aperture of one-fiftieth of an inch in diameter, for the paper one of one-eighth of an inch in diameter, putting in a coated plate, allowing it to remain for fifteen minutes, and coating it with mercury in the usual manner. The result was a beautiful picture, similar to the one I herewith have sent you.

It was self-evident now that we had the means to do that with one camera for which two were before deemed indispensable; namely, taking two stereoscopic pictures through two apertures situated only 2½ inches apart; but as a quarter-size plate is only 4¼ inches long, and as it was desirable to take the two pictures on one plate, two apertures, 1-66 of an inch in diameter, were made in the metal plate above alluded to, only 2¼ inches apart. After twenty minutes' exposure, the sun shining on the house all the time, the pictures which I send you were the results; thus demonstrating conclusively that two stereoscopic pictures can be taken on one plate, with one camera (or dark chamber without lenses), and simultaneously, without either reflectors or refractors of any kind whatsoever. It may here be remarked, however, that the pictures thus taken on one plate are stereoscopic reverse; that is to say, the right picture is on the side where the left one ought to be, and *vice versâ*, which can, however, be very readily remedied by cutting the plate in two and pasting them together again properly. This stereoscopic reverse was next attempted to be remedied by placing a reflector before the apparatus; but the only effect produced by this device was the same as the reflector produced upon pictures taken by an ordinary camera, viz., making the pictures appear in their natural position, so that letters on signs, &c., could be read directly.

There is another advantage resulting from this camera; it is this: you may make two, four, six, or more sets of holes in the same camera, either all of the same diameter, by which means you will obtain an equal number of stereoscopic pictures with the number of sets of holes; or you may make one set with an aperture 1-200 of an inch, another 1-100 of an inch, one set 1-70 of an inch, and still another set with 1-25 of an inch diameter; when you will be almost certain to obtain at least one set of pictures, "properly timed."

Sensitive Collodion.—Dr. Thomas Woods thus describes, in the *Journal of the Photographic Society*, his formula, than which he knows of no process more sensitive or certain.

Take of sulphate of iron, 40 grs.; iodide of potassium, 24 grs.; chloride of sodium (common salt), 6 grs.; alcohol, 2 oz.; strong water of ammonia, 3 drops. Mix the powdered salts together and add them to the alcohol, then the water of ammonia. A few pieces of iron wire must be kept in the mixture to prevent the iron becoming peroxidized.

One part of this mixture is to be added to three parts of collodion holding in solution an *alcoholic* solution of common salt in the proportion of 1 fluid drachm of salt to 4 oz. of collodion. Or, neglecting the salt solution, 5 drops of *chloroform* may be added to 1 drachm of the solution of iodide of iron and 3 drachms of *plain* collodion. The mixture of collodion and iodide of iron ought to be used shortly after having been made, as the iron becomes peroxidised and spoilt by a prolonged contact with the collodion.

The nitrate of silver solution for exciting the plate should be of the strength of 30 grs. to the ounce of water.

The developing solution may be either the ordinary sulphate of iron, or the pyrogallic acid.

With a good lens and a good light an almost instantaneous picture may be produced by this process.

A little water of ammonia added to the hyposulphite bath brings out the picture more fully when a very short exposure is given.

Sometimes the common table salt contains a little *carbonate* of soda; if such be used in the process, it causes cloudiness.

Dry Collodion.—Mr. Mayall has communicated to the *Athenæum*, No. 1437, a new process which he has compounded, for using collodion dry. The usual plain collodion is excited with—(No. 1.) 3 grains iodide of cadmium; 1 grain chloride of zinc; 1 oz. collodion; ¼ oz. alcohol. Dissolve the chemicals in the alcohol, and then mix with the collodion: or (No. 2.) 3 grains iodide of zinc; 1 grain bromide of cadmium: or (No. 3.) 2 grains iodide of cadmium; 1 grain bromide of cadmium; $\frac{1}{80}$ grain bromide of iron; $\frac{1}{20}$ grain bromide of calcium. In the last it will be necessary to dissolve 1 grain of bromide of iron in 1 drachm of alcohol, and use 1 fluid grain of the solution. Similarly 3 grains of bromide of calcium must be dissolved in 1 drachm of alcohol, and use 1 fluid grain. The excited collodion will require to stand a few days to completely settle. Decant into a dry bottle to avoid sediment. Spread as usual.

Bath of albuminate of silver.—16 ounces distilled water; 1 ounce albumen; 1¾ ounce nitrate of silver (neutral); 1½ ounce glacial acetic acid; 2 grains iodide of potassium. The albumen and water must be well mixed first, then the glacial acetic acid added; shake up and stand three hours, then the nitrate of silver in crystals, shake and filter, stand twenty-four hours, then add the iodide of potassium, filter again ready for use. Coat the plate as usual with collodion, and use the albuminate of silver bath as an ordinary silver bath; wash in another bath of distilled water five minutes, then wash the back of the plate with common water, the front with distilled; set the plate aside to dry, vertical position, in a place free from dust. It will keep three weeks. Expose in the camera as usual, from two minutes to ten, according to the light, diaphragm, &c. Pass into the silvering bath again three minutes. Develop with 6 grains proto-sulphate of iron; 1 ounce distilled water; 1 drachm glacial acetic acid. Wash, and fix with 1 cyanide of potassium; 20 water. It is about as quick as albumen in the camera. The albuminate of silver bath must on no account be exposed to daylight, nor the developing solution. Potassium and ammonium salts will do to excite the collodion; but it will not keep so long as with the metallic iodides.

Lithographs by the Photographic Process.—Professor Ramsey has described to the British Association a process by which Mr. Robert M'Pherson, of Rome, had succeeded in obtaining beautiful photo-lithographs, specimens of which had been hung up in the Photograph Exhibition in Buchanan-street. The steps of the process are as follows:—1. Bitumen is dissolved in sulphuric acid, and the solution is poured on an ordinary lithographic stone. The ether quickly evaporates, and leaves a thin coating of bitumen spread uniformly over the stone. This coating is sensitive to light, a discovery made originally by Mr. Niepce, of Chalons. 2. A negative on glass, or waxed paper, is applied to the sensitive coating of bitumen, and exposed to the full rays of the sun for a period longer or shorter according to the intensity of the light, and a faint impression on the bitumen is thus obtained. 3. The stone is now placed in a bath of sulphuric ether, which almost instantaneously dissolves the bitumen, which has not been acted upon by light, leaving a delicate picture on the stone, composed of bitumen on which the light has fallen. 4. The stone, after being carefully washed, may be at once placed in the hands of the lithographer, who is to treat it in the ordinary manner with gum and acid, after which proofs may be thrown off by the usual process. Professor Ramsey then proceeded to state that the above process, modified, had been employed with success to etch plates of steel or copper, without the use of the burin:—1. The metal plate is prepared with a coating of bitumen, precisely in the manner noticed above. 2. A positive picture on glass or paper is then applied to the bitumen, and an impression is obtained by exposure to light. 3. The plate is placed in a bath of ether, and the bitumen not acted upon by light is dissolved out. A beautiful negative remains on the plate. 4. The plate is now to be plunged into a galvano-plastic bath, and gilded. The gold adheres to the bare metal that refuses to attach itself to the bitumen. 5. The bitumen is now removed entirely by the action of spirits and gentle heat. The lines of the negative picture are now represented in bare steel or

copper, the rest of the plate being covered by a coating of gold. 6. Nitric acid is now applied as in the common etching process. The acid attacks the lines of the picture formed by the bare metal, but will not bite into the gilded surface. A perfect etching is thus obtained.

Gallic Acid as a Developing Agent.—Mr. William Crookes, in a letter to the *Philosophical Magazine*, No. 58, says:—

Having undertaken the arrangement of the department in the Radcliffe Observatory, Oxford, in which photography is applied to the registration of the various meteorological phenomena, and having for many reasons decided upon the use of the wax-paper process* as that best adapted to the purpose, I have naturally been anxious to avail myself of any improvements which may tend to diminish the labour or contribute to the general perfection of the result. This I do as follows:—

Two ounces of gallic acid are to be dissolved in 6 ounces of alcohol (60° over proof); to hasten solution, the flask may be conveniently heated by immersion in hot water; when cold, it should be filtered, mixed with half a drachm of glacial acetic acid, and preserved in a stoppered bottle for use; so prepared, it will keep unaltered for a considerable length of time. The gallic acid is not precipitated from this solution by the addition of water; consequently, if in any case desirable, the development of a picture may be effected with a much stronger bath than the one usually employed.

To obtain a solution of about the same strength as a saturated aqueous solution, half a drachm of the above would require to be added to 2 ounces of water; but for my particular purpose I prefer a weaker bath, which is prepared by mixing half a drachm with 10 ounces of water. In either case it will be found necessary to add solution of nitrate of silver in small quantities as the developing picture seems to require it.

Application to Experiments on Diffraction.—Mr. John Bridge, M.A., has communicated to the *Philosophical Magazine*, No. 66, the following means by which the principles of the interference of light may be illustrated in great variety.

If, says Mr. Bridge, we look at a line of light through a series of equidistant lines ruled on glass, lateral spectra are produced, whether a telescope or only the naked eye be employed. Here is then an experiment which may be performed in a simple manner; and to make it a popular experiment, it is only necessary to produce these lines cheaply. It occurred to me to do this by taking a collodion picture, as small as desired, of a series of lines ruled on a scale as large as may be necessary to ensure accurate equi-distance. When I had succeeded (to a considerable extent) in this, it seemed to me by bringing the circles, triangles, or other figures used in Sir John Herschel's experiments within the space of the pupil of the eye on a collodion plate, that series of beautiful phenomena might be produced without the employment of a telescope, or at any rate by the employment of a telescope of very low power.

The degree of success which I have obtained is sufficient to assure me that these beautiful experiments may thus be placed within the reach of all, and to justify the expectation that any one who possesses the necessary skill and other advantages may convert this, not only into a popular, but an accurate and scientific experiment.

Besides the lines giving lateral spectra, I have produced regular series of a large number of circles, triangles, &c., within the space of the pupil of the eye, so that the phenomena may be seen in a variety of forms by the unaided eye. This is, I suppose, scarcely possible by any other means than photography.

Improved Apparatus.—Mr. J. C. Bourne, artist, of Kentish Town, has patented certain improvements, consisting—1. In constructing photographic apparatus in such manner, that the box or case in which the camera is contained may serve as a foundation on which the camera may be supported when in use; and so that, when out of use, the front part of the camera may be folded into the back part, and be placed in a compartment within the box. 2. In constructing the box or case, so that when opened it may form a base for a tent, which is constituted by means of a lath fixed on a centre or pivot at each angle of the inside of the box, the several laths being raised and united at the top in pairs, so as to form, as it were, two gable ends, in order to support a covering of suitable fabric, within which the operations of preparing the sensitive surface, developing the photographic pic-

* *Notes and Queries*, vol. vi. p. 443.

ture, &c., may be performed. 3. In providing for adjusting the position of the lens of the camera, so as to place it always in the direction of a curve, the radius of which is the focal length of the lens.

Système Garnier de Photocherographie coloriée.—This invention, patented by M. Garnier, of Guernsey, consists—1. In employing a textile or woven fabric instead of paper to receive photographic pictures; and the inventor having found by experience that photographic pictures are liable to fade away, and that this defect arises from the presence of certain salts or matters in the fabric employed to receive the picture, he proposes, 2. to subject the fabric to the operation of boiling water, which will neutralize, destroy, or remove the deleterious or injurious matters, and prevent them from operating on the chemical substances employed in the photograph process.

PRESERVATION OF FOOD.

THAT meat can be preserved at temperatures below the freezing point is well known, of which fact the frozen markets of St. Petersburg afford an example; but the most remarkable instance of preservation by frost is that of the Siberian mammoth, which is supposed to have been buried under the ice several thousands of years, and when first exposed from its icy covering the flesh was quite fresh, and was eaten by dogs. The effect of exposure to air is to decompose by the combination of the oxygen of the atmosphere with the complicated compounds of animal organisation; and that effect is increased by the presence of moisture. It is a common opinion that the light of the moon facilitates decomposition: the foundation of which notion may be traced to the circumstance that on clear moonlight nights there is a greater deposition of dew than under a cloudy sky. The two great practical principles on which the preservation of meat and vegetable substances has been accomplished is by isolation, and by coagulation of the albumen. The covering over of the articles with a silica glaze has been practised, by which means the air is excluded, and decomposition prevented. Meat and eggs have been preserved fresh in that manner for six months. The practice of covering meat with flour also tends to preserve it, by diminishing the action of the air, and by absorbing moisture. The most common plan, however, of preserving meat is by salting it, the effect of which is to extract the moisture; and the sensation of thirst caused by eating salted provisions may be ascribed to the absorption of moisture by the salt. The coagulation of the albuminous parts of organized matter by heat is also a great preservative; that principle has been extensively adopted in France, the mode of operation being first to expose the substances to highly heated steam, of about three or four atmospheres of pressure, and afterwards to dry them with hot air. The plan most generally followed, however, is to exclude the air, either before or after the substances are cooked. By Mr. Gamble's process the meat is placed in tin cases and immersed in hot water till the albumen is coagulated, after which the cases are carefully sealed. Mr. Goldner encloses the meat in tin cases, from which the air is exhausted by the condensation of steam, and the cases are then hermetically sealed. When cooled, the pressure of the atmosphere collapses the tins; and one test of the preservation of food in this manner is the maintenance of the collapsed form, for if decomposition takes place, the gases evolved expand the cases.—*The Rev. J. Barlow, at the Royal Institution.*

Natural History.

ZOOLOGY.

MUSCULAR CONTRACTION.

DR. C. BLAND RADCLIFFE has communicated to the Royal Society a paper on "The Physical Theory of Muscular Contraction." The theory set forth in this paper is, that muscle is *prevented from contracting* by the several vital and physical agencies which act as stimuli upon muscle —volition, nervous influence, blood, electricity, light, heat, and the rest—and that *contraction happens on the cessation of stimulation*, by virtue of the operation of that universal principle of attraction which belongs to muscle in common with all matter; and, so happening, that it is a *physical* phenomenon of the same nature as that contraction which takes place in a bar of metal on the abstraction of heat. This theory is supported by various arguments, some of which are now stated for the first time.

SEALS ON THE WESTERN COAST OF IRELAND.

THERE have been read to the Linnean Society extracts of two letters addressed to the President, by Mr. Henry Evans, of Darley Abbey, near Derby, relative to Seals killed by him on the western coast of Ireland. The writer gives some interesting particulars with respect to the habits of the common Seal (*Phoca vitulina*), which frequents, in considerable abundance, the inland bays near Roundstone, as many as two dozen having been occasionally seen in one day, though so shy and wary that it was difficult to get within a hundred yards of them. The larger seals keeping further out to sea, and frequenting rocks that can be approached only in the calmest weather, are far more difficult to meet with. On one of these rocks, about eight miles from Roundstone, Mr. Evans once succeeded in getting a shot at an immense seal, about eight feet in length, white, with a large black patch on each side, which he had not the slightest doubt was a male of the rare harp seal (*Phoca Grœnlandica*), an opinion which, from this description of its markings, the president confirmed; unfortunately the animal got away into deep water after receiving two rifle balls. He had one companion, apparently a female, of the same species. Near an island called Mynish, some ten miles from Roundstone, Mr. Evans succeeded in obtaining a specimen of another larger seal (*Halichærus gryphus*), which afforded great sport, having led his pursuers a chase of upwards of a mile, after having been shot through the head with a rifle-ball, which passed through one eye and out below the other. This fellow displayed astonishing tenacity of life; having been partially stunned by a second shot in the head, he was hauled into the boat, where he was lashed down, but was so far from being dead on the party reaching Roundstone, that it was an hour's work, of no slight difficulty, to secure him on a hand-

barrow. He was then carried up to the hotel, where he was left for the night, in the hopes of his speedy demise. Next morning, however, he was sufficiently recovered to spring three or four yards at a bound, towards a man who was passing; and things growing rather serious, Mr. Evans was eventually called up to finish him.

ASIATIC SHEEP.

Among the sheep peculiar to Turkey and Asia, and hitherto unknown in Europe, is a breed called the Karamanli, generally met with in the neighbourhood of Broussa, where large flocks of them are bred, and where they are in high estimation for their flesh and their wool, but more particularly for their tails, which when boiled down yield as much as 7½ kilogrammes of excellent fat. This fat keeps good much longer than butter, and replaces it in case of need. The Zoological Society for the introduction of animals into France has decided on purchasing twenty-five Karamanli, fifteen to be sent to Algeria, where it is thought they will answer very satisfactorily.

GUANO IN THE PACIFIC OCEAN.

Statements have occasionally appeared in the newspapers respecting an immense deposit of guano recently discovered in a remote part of the Pacific Ocean by an American sea-captain, with allusions to a Company organizing for the purpose of rendering it available for agricultural purposes. The latter project is now so fully matured, and the co-operation of the United States' Government has been so effectually secured, that two ships had been despatched by the Company—one from the Atlantic and one from the Pacific, and a vessel belonging to the United States' Pacific squadron has also been ordered to convey two agents of the Company to the island, to protect the interests of the company, survey the harbour, and estimate the character and quantity of the guano. One of the ships referred to is the *Corea*, which sailed from New London on the 18th of August last, with orders to touch at Talcuhan, South America, to take on board the agent of the Company. One of the discoverers of the island made an affidavit before the members of the Cabinet at Washington, that in the year 1832 he discovered and landed on a certain barren and uninhabited island situated in the Pacific Ocean, more than 500 miles from the main land, and more than 200 from any adjacent island; and that he had been cruising in those seas anterior to the time of the said discovery. This island is claimed to possess unequalled advantages for anchoring and loading vessels. From the Chincha Islands, which have no harbour, there were exported last year over 400,000 tons of guano.—*New York Journal of Commerce.*

CALIFORNIAN WOODPECKER.

Mr. A. Murray has read to the Royal Society a notice of a singular instinct possessed by a Californian Woodpecker, which is said to lay up a store of provisions for winter use, by boring holes in the bark of trees and placing in them acorns. A habit so singular and so little known among birds was listened to with some doubt, but on examining

into the subject we find so many naturalists adverting to it that we cannot now refuse to give it credit. In the very beautiful work on the *Birds of California and Texas*, by Mr. John Cassin, now in the course of publication in America, we find this passage:—

"Dr. A. L. Heermann, of Philadelphia, has identified, for the first time, this species of woodpecker, of which previously nothing could be accurately made out from the statements of travellers, and which was stated to possess the provident and curious instinct of storing away a supply of food for the winter in holes made for that purpose in the bark of trees.

"In the autumn this species is busily engaged in digging small holes in the bark of the pines and oaks, to receive acorns, one of which is placed in each hole, and is so tightly fitted or driven in that it is with difficulty extracted. Thus, the bark of a large pine, forty or fifty feet high, will present the appearance of being closely studded with brass nails, the heads only being visible. The acorns are thus stored in large quantities, and serve not only the woodpecker in the winter season, but are trespassed on by the jays, mice, and squirrels."

BIRDS FROM THE PERUVIAN ANDES.

MR. GOULD has exhibited to the Zoological Society a portion of a collection of Birds, formed by Mr. Hauxwell in a district lying on the eastern side of the Peruvian Andes, in the neighbourhood of the river Ucayali, one of the tributaries of the Upper Amazon. Mr. Gould observed that the exploration of this district had been one of the earliest objects of his own ambition, but that until within the last few years no naturalist had visited it. The splendid collection sent by Mr. Hauxwell, of which the birds exhibited formed a part, fully bore out the anticipations entertained by Mr. Gould, that when explored it would prove one of the richest and most interesting ornithological districts with which we are acquainted. Among the birds exhibited were some Cotingas, differing from the ordinary species found in the lower countries of Brazil, and remarkable for the splendour of their colouring, together with species of Phœnicercus, Rhamphocelus, &c., of the most dazzling brilliancy. As a contrast to these, Mr. Gould exhibited a series of dull-coloured birds (Thamnophili), also contained in the collection, and remarked that this striking difference in the colouration of birds inhabiting the same locality was due entirely to their different degrees of exposure to the sun's rays; the brilliantly-coloured species being inhabitants of the edges of the forests, where they fly about amongst the highest branches of the trees, whilst the others form a group of short-winged insectivorous birds which inhabit the low scrub in the heart of the dense humid jungle, where the sun's rays can rarely, if ever, penetrate. Mr. Gould also remarked that the colours of the more brilliant species from the banks of the Ucayali,—a district situated towards the centre of the South American continent,—were far more splendid than those of the species which represented them in countries nearer to the sea; and from this circumstance he took occasion to observe that birds from the central parts of continents always possess more brilliant colours than those inhabiting insular or maritime situations. This rule applies even to birds of the same species,—the

Tits of Central Europe being far brighter in colour than British specimens. Mr. Gould had observed a like difference between specimens of the same species inhabiting Van Diemen's Land and the continent of Australia. He attributed this principally to the greater density and cloudiness of the atmosphere in islands and maritime countries; and in further illustration of the influence of light upon colour, he remarked that the dyers of this country can never produce tints equal in brilliancy to those obtained by their continental rivals, and that in England they never attempt to dye scarlet in cloudy weather.

NEW REDSTART.

Mr. Gould has described to the Zoological Society a new species of Redstart from Erzeroum. For this species, which is nearly allied to the common Black Redstart of Europe, *Ruticilla Tithys*, Mr. Gould proposed the name of *Ruticilla erythroprocta*, its most striking distinction from the European species being the red colour of the lower part of the abdomen.

NEW TANAGER.

Mr. Sclater has read to the Zoological Society a paper containing characters of two new species of Tanagers, *Dubusia auricrissa*, and *Tridornis porphyrocephala*. Since compiling his list of Bogota Birds, in which Mr. Sclater had included the first-mentioned species under the name *D. cyanocephala*, he had examined D'Orbigny's types of that bird in the Paris Museum, and found them so different from the present as to lead him to conclude that they were specifically distinct. This bird is common in collections from Bogota. The examples of *D. cyanocephala* in the British Museum were procured by Mr. Bridges in Bolivia. Mr. Sclater, in 1854, first noticed a specimen of the second species *Tridornis porphyrocephala* in the Museum at Berlin under the name *Tanagra analis* (Tschudi), but having, just previously, had the opportunity of examining type specimens of the latter in the collections of Brussels and Bremen, he saw at once that the present was a distinct, although closely allied, species. He, therefore, now introduced it as new to science under the title of *Tridornis porphyrocephala*.

NEW HUMMING-BIRDS.

Mr. Gould has brought before the notice of the Zoological Society a remarkably fine specimen of Humming-bird, which he had lately received from Ecuador. This new bird is remarkable for its large size, deeply-forked tail, and the harmonious hues of its plumage, which, although less glittering and metallic than in many other species, is, nevertheless, strikingly beautiful. Mr. Gould considered this bird to be new to science both generically and specifically; and as the name of *Victoria regia* had been given to one of the finest flowers of the same part of South America, he was desirous of dedicating this new humming-bird to the Empress of the French, and he accordingly proposed to name it *Eugenia imperatrix*. Its native habitat is the vast Andean forests, in the neighbourhood of Quito in Ecuador, where it procures its insect food from the bell-shaped flowers of the Daturæ.

Mr. Gould has also brought before the Society two other beautiful

species of humming-birds, which he believed to be new to science. He stated, that they belonged to that section of the Trochilidæ to which the generic appellation of Heliothrix has been given. Of this form only three species had been previously characterized,—namely, *H. auritus*, *H. auriculatus*, and *H. Barroti*. One of these new species, for which the specific name of Purpureiceps is proposed, is nearly allied to *H. Barroti*, but differs from that bird in having a much shorter bill, in the blue of the head being of a paler purple, and in that blue not being confined to the crown, but extending some distance down the nape of the neck. This species was obtained from the districts near Popayan. The second species, for which the name of Phænolæma was proposed, has several characters in common with *H. auritus* and *H. auriculatus*. It differs, however, from both these species in the beautiful metallic green colouring, extending over the throat and front as well as the sides of the throat. The habitat of this species is on the River Napo.

NEW PRION.

Mr. Gould has described to the Zoological Society a bird which he conceived to be a new species of Prion, and which had been captured on the Island of Madeira, or on the neighbouring rocky islets, called the Desertas. Mr. Gould also exhibited five other species (forming part of his own collection), which he considers to belong to the same beautiful group, and which had been captured by himself during his voyages to or from Australia. The entire series present a great similarity in the colour of their plumage; but a great diversity in the breadth, or lateral development of their mandibles, as well as in the fringe-like pectinations of the base of the upper mandible, this latter character being much more prominent in the larger than in the smaller species of the group, in which, indeed, it is almost obsolete, if not entirely absent. Mr. Gould considered the members of this genus to constitute a very distinct group among the petrels, quite equal, in point of interest and value, to that of the Thalassidromæ. For this new species, indubitably distinct from all previously known, and the only one which ever has, as yet, occurred to the north of the line, Mr. Gould gave the name of *Prion brevirostris*.

EAGLES.

We learn from Skye, that Kenneth Macdonald, trapper to Mr. Donald C. Cameron, Tallisker, has shot and trapped on the farm of Tallisker, since July last, nine eagles—some of large size, and four of the number within a fortnight. An immense golden eagle measured across the extent of the wings 7 feet 11½ inches. Another, a white-tailed sea eagle, or *Haliaetus Albicilla*, measured 7 feet 10 inches, and was a remarkably fine bird. It grieves one to chronicle the extirpation of these fine creatures; but besides being very destructive to game, the eagles carry off young lambs, and cause heavy losses on some of the sheep-farms.—*Inverness Courier*.

WREN'S NEST.

As two sawyers were cutting a log of Stettin oak, 26 inches square,

at Sunderland, about the centre of the log, a large hole was discovered, $10\frac{1}{2}$ inches in length by $7\frac{3}{4}$ inches in breadth, filled with moss, feathers, hair, &c., and containing seven bird's eggs, which, from their diminutive size, are considered to be wren's eggs. The tree, from its immense size, is supposed to be of about 150 years' growth. The moss forming the wren's nest was as fresh as if it had only been pulled yesterday.—*Durham Chronicle.*

SINGULAR MORTALITY AMONGST THE SWALLOW TRIBE.

Mr. E. J. Lowe, in a paper read by him to the British Association, observes:—There has seldom been recorded a more singular circumstance than the Mortality amongst the Swallow tribe which occurred on the 30th and 31st of May in 1855. The unusually cold weather for the advanced season appears to have operated in producing the destruction of the greater number of this useful tribe of migratory birds; the severity of the weather causing a scarcity of insects (the ordinary food of the swallow), and rendering the birds too weak to enable them to search for food. On the 30th of May the swallows became so tame that they flew about the legs of persons, and could be caught without difficulty, and on the following morning most of them lay dead upon the ground or in their own nests. In this neighbourhood (near Nottingham) the greatest mortality was occasioned amongst the house swallow (*Hirundo rustica*), yet solely because this bird predominates. Near the Red Tunnel at Thrumpton there are great numbers of sand-martins (*Hirundo riparia*), and there, in a saw-pit on the banks of the river Soar, hundreds congregated and died. At Borrowash, near the Derwent river, there are very many white martins (*Hirundo urbica*); they also congregated and died, lying ten and twelve deep on the different window-sills. Several persons opened their windows, and the birds were very willing to take shelter in the rooms, exhibiting no disposition to depart. Many were kept alive in the different houses by being fed with the *aphis* of the rose-tree, the only procurable insect. At Bulwell, Wollaton, Long Eaton, Gawley, and many other places, the same fearful mortality occurred. Farmers opened their barn-doors to admit the birds. To show the extent of the deaths, it may be mentioned that at one place where previously there were fifty nests occupied, only six pair survived to take possession of them. The manner in which they congregated was a curious feature in the occurrence. A swallow would fly round a heap of dead and dying companions, and then suddenly dart down and bury itself amongst them. On the same days, in the vale of Belvoir, and in parts of Nottinghamshire and Lincolnshire, several hundred newly-shorn sheep perished.

BIRDS IN THE MUSEUM OF THE EAST INDIA COMPANY.

There are many valuable zoological collections in Great Britain, but most of them are comparatively useless from want of a catalogue or arranged list of the contents. Among these ranked the Museum of the Honourable East India Company, which has now set an example, by publishing the first part of the catalogue of its ornithological collection. This Museum has been long known as a valuable one, particularly in

that department now being catalogued. Among its contents are the collections of drawings which have served as the foundations of many of the species described by Dr. Latham, and which still continue as the sole authority for some of these. All the labours of Sir Stamford Raffles and Dr. Horsfield are there; as well as the whole or part of the collections of General Hardwicke, Colonel Sykes, M'Clelland, Falconer, Hodgson, Strachey, Tytler, &c., &c.

The Catalogue has been published under the superintendence of Dr. Horsfield; but the actual labour of compiling it has devolved upon Mr. F. Moore, the assistant curator, who has executed his work well. The systematic arrangement proposed by the late N. A. Vigors has been followed, and the volume now printed contains the *Raptores* of the collection, 103 species, and a portion of the *Incessores*. Extracts from various printed works of the donors of the specimens and drawings are introduced, where they relate to the habits of the species.—*Edinburgh New Philosophical Journal*, No. 2.

FOOD OF GREGARIOUS FISHES.

A MEMOIR "On the Food of certain Gregarious Fishes," by Dr. Knox, has been communicated to the Linnean Society. Struck with the very great difference of opinion among naturalists as to the food of some *salmonidæ*, &c., Dr. Knox was induced many years ago to devote considerable attention to the subject, the inquiries, of which the results are given in this paper, having been commenced about the year 1824, and repeated many times since. In the course of Dr. Knox's researches, his attention was early called to the fact, that in the stomachs and intestines of fresh sea-salmon (*i.e.*, of salmon fresh from what, in his opinion, is their only true feeding-ground, the unknown recesses of the ocean) nothing is ever found but a peculiar reddish substance, unlike anything known to possess life. On applying to practical fishermen for information on this subject, he found them all to agree in the opinion that the food of the salmon, whilst resident in the ocean, was altogether unknown; and they were equally at fault with regard to that of the herring. Whilst reflecting on these circumstances, Dr. Knox learnt accidentally that, in a lake, or lakes, near Lochmaben, there was a small fish in great abundance, which could not be tempted by any bait, and whose food was entirely unknown. With this fish, the vendace, he resolved to commence the inquiry, and accordingly proceeded to visit the lakes where it occurs. Dozens of vendaces were speedily taken with the net, and on their stomachs being examined immediately on their being removed from the water, they were found to be crammed with thousands of *entomostraca*, or microscopic shrimps. Those first discovered belonged to the genus *lynceus*, but several other genera were observed, and in winter (Dec. 14, 1832) several species of *cyclops* were most abundant. Thus, instead of living on *air* or water, the vendace doubtless consumes daily thousands of minute shell-fish. After giving an interesting account of the habits and general natural history of the vendace, the author reverts to the more immediate object of his paper, the food of gregarious fishes, his next subject being the char. Of this fish some specimens were obtained from Windermere, which were found to

have fed upon the *entomostraca* so abundant in the lake. These, doubtless, form the larger portion of its natural food ; it does not seem, however, to feed exclusively upon them, as though shy of taking any bait, it will rise to a fly, and the common food of the trout may likewise be found in its stomach. The early spring, or grey trout of Loch Leven (which comes into season in December, continuing in condition till May), appears to feed exclusively on *entomostraca*, while the ordinary Loch Leven trout live on the *buccinum*, with which the lake abounds, rise readily to a fly, and may, no doubt, be taken with a worm, minnow, or any ordinary bait for trout.

Dr. Knox next proceeds to investigate the natural food of the herring, which, when in the deep sea, and in its finest condition, he finds to consist almost wholly of various species of *entomostraca*, having met with only three exceptions to this rule among hundreds and hundreds of herrings examined at a distance from the shore. Of these three individuals, one had been living on sand-eels, another on what appeared to be small herrings; and in the stomach of the third were found about a dozen small *buccinums*. When taken near the coast, the herring is usually about to spawn, at which period it does not appear to feed ; but after having spawned, and whilst close to the shores, they seem to take to other food beside *entomostraca*, as sand-eels and shrimps. Herrings taken off Dunbar, in June, 1831, were found to be in this state, the stomach and intestines loaded with putrescence, the fish worthless and insipid. Dr. Knox having written to his former pupil, Mr. H. D. Goodsir, for information on this subject, that gentleman, in a letter dated Anstruther, 15th June, 1843, states, that "the *entomostraca* are at certain seasons the almost exclusive food of the herring. There can be no doubt either that they follow shoals of these crustacea to prey upon them, for it is only when the latter make their appearance on this coast that the former are seen, and when this food is most plentiful the herring are in best condition." Mr. Goodsir adds that it is chiefly during the winter and spring months that the herring take other kinds of food than the *entomostraca*, the stomach during these months being oftener found empty, and only occasionally filled with the larger crustacea, such as shrimps, &c. ; and he further states that there can be no doubt that during the summer months, when the shoals of *entomostraca*, which the fishermen term *maidre*, are in great abundance, they form the food of a great number of other animals besides the herring. He mentions particularly the common coal-fish, and expresses his belief that the shoals of *cetacea* which make their appearance in the Frith during the herring season, are in pursuit of the *maidre*, and not, as generally thought, of the herring. The salmon, from the time it enters the fresh-water rivers, ceases to feed, properly speaking, although it may occasionally rise to a fly, or be tempted to attack a worm or minnow. Whilst living as a smolt in fresh water its food is the ordinary food of trout; but as it never again resorts to this food after it has once entered the ocean, the question arises, On what does it subsequently feed? Nothing is ever found in the stomach and intestines of the fresh-run salmon but a little reddish substance. Some of this Dr. Knox placed under the microscope, and after a careful examination,

came to the conclusion that it was composed of the ova of some species of the *Echinodermata*. Of the salmon, whilst in the sea, this is the constant and sole food.

OVA OF THE SALMON.

Dr. John Davy has communicated to the Royal Society "Some Observations on the Ova of the Salmon, in relation to the distribution of Species." The author describes a series of experiments on the ova of the salmon, made with the intent of ascertaining their power of endurance under a variety of circumstances without loss of life, with the expectation suggested by Mr. Darwin, that the results might possibly throw some light on the geographical distribution of fishes.

The details of the experiments are given in five sections. The results obtained were the following:—

1. That the ova of the salmon, in their advanced stage, can be exposed only for a short time to the air, if dry, at ordinary temperatures, without loss of life; but for a considerable time, if the temperature be low, and if the air be moist; the limit in the former case not having exceeded an hour, whilst in the latter it has exceeded many hours.
2. That the vitality of the ova was as well preserved in air saturated with moisture, as it would have been had they been in water.
3. That the ova may be included in ice without loss of vitality, provided the temperature is not so low as to freeze them.
4. That the ova, and also the fry recently produced, can bear for some time a temperature of about 80° or 82° in water, without materially suffering: but not without loss of life, if raised above 84° or 85°.
5. That the ova and young fry are speedily killed by a solution of common salt nearly of the specific gravity of sea-water, viz., 1026; and also by a weaker solution of specific gravity 1016.

Finally, in reference to the inquiry regarding the distribution of the species of fishes, he expresses his belief that some of the results may be of useful application, especially those given in the second and third sections; inferring, that as in moist air, the vitality of the ova is capable of being long sustained, they may during rain or fog be conveyed from one river or lake to another adhering to some part of an animal, such as a heron or otter, and also during a time of snow or frost; and, further, that other of the results may be useful towards determining the fittest age of ova for transport for the purpose of stocking rivers, and likewise as a help to explain the habitats, and some of the habits of the migratory species.

ARTIFICIAL SALMON BREEDING POND.

The success of the Artificial Breeding of Salmon in the Experimental Pond formed for that purpose at Perth, in 1853, is now established; and that long-disputed point which has been carried on with pertinacious tenacity between the rival parties of the two opinions for many years,—viz., as to whether the smolt returns from the sea the year it goes down to the new element a grilse, or the year after, is finally settled. Three fine grilse, one of them particularly handsome in shape and beauty, were lately brought, two from Newburgh, and one from one of the town's fishings at Darry Island, the younglings of the experimental breeding pond. The marks, the cutting off of the dead fins, and their

being completely healed, were evidence to the most sceptical of the certainty of the grilse being those of the smolts of the pond, liberated to find their way to the sea on the 29th of May last. The best fish which have just been mentioned, was in length 25⅝ inches, circumference 12½ inches, and weight 5½ lbs. The other two from Newburgh, not so finely formed, were 3½ lbs. and 5 lbs. respectively. Mr. Buist, the session-clerk, of Perth, who has been the life of the experiment, certainly deserves great credit for his patience, perseverance, and attention to pushing it towards a consummation. (See also pp. 215, 216, 217, 218.)

STOCKING PONDS WITH FISH.

It is well known that when Fish are confined to a small volume of water, the more delicate kinds very soon sicken and die. This is caused by their rapidly consuming all the air naturally contained in the water, when suffocation takes place. In a recent conveyance of some grayling from the river Wye, in Derbyshire, to Scotland, this was obviated by attaching a small force-pump to the side of the vessel with a pipe to the bottom, by which simple means a constant supply of air was kept bubbling up through the water, and the necessity of a constant change of water saved. The stocking of ponds, lakes, and rivers with new varieties of fish, and improved breeds, will now be a comparatively easy matter. This was the first occasion on which the invention had been tested, and it has been very successful.—*North British Daily Mail.*

A number of trout, salmon, and other fish hatched in the apparatus of Professor Coste, at the College of France, were about a year previously cast into the lake of the Bois de Boulogne, the average length of them being then from one and a half to two inches. A number of them being caught, in order to ascertain how they were getting on, it was found that they had grown on an average from four and three quarters to six inches. If the fish had been placed in rivers, such as they generally frequent, they could not have grown more rapidly. The success of the breeding of these sorts of fish in still water may therefore be considered as assured.

SHOALS OF DEAD FISH OBSERVED ON THE PASSAGE BETWEEN MIRIMACHI, NEW BRUNSWICK, AND THE PORT OF GLOUCESTER.

The following is an extract from a letter received from the Rev. W. S. Symonds, of Pendock Rectory, Gloucestershire, to whom the particulars were communicated by Mr. John Jones, Austrian Vice-Consul at the port of Gloucester:—

"Enclosed in a little box is a dried specimen of a small 'gar fish,' and a paper containing notes from the log-book of Captain Parsons, of the ship *Harbinger*, of the track and dates in which the fish was found on the passage between Mirimachi, New Brunswick, and the port of Gloucester. It was impossible, in the great distance through which he sailed, to pull up a ship's bucket without four or five dead gar fish. It appears the fish were most numerous in that latitude through which the volcanic band of Iceland, the Azores, the Canaries, and Madeira just strikes: I believe, therefore, that the immense shoals must

have been destroyed by submarine volcanic action; and we may thus learn a lesson of the manner in which some of our fish-beds have been formed, and even of the destruction of genera and species."

Upon this Sir William Jardine observes :—

"The above short extract is of very great interest. The specimen of the fish itself, as nearly as can be made out from the state in which it was dried, is the *Sygnathus anguineus*—a species inhabiting the British seas, but having a considerable extent of range southward. Mr. Yarrell informs me, he has seen specimens from the latitude of Madeira; and this fact is of some importance, as it renders it more probable that the destruction was caused by submarine disturbance taking place within the zone to which Mr. Symonds alludes."—*Edinburgh New Philosophical Journal*, No. 2.

EFFECTS OF FROST ON SHELL-FISH.

The intense frost of last winter—coincident at new moon with a stream tide—has killed many of the littoral shell-fish around our shores; and they now lie by thousands and tens of thousands along the beach. On the beach below Portobello, and for at least a mile on the western side of the town, they are chiefly of two species,—*Solen siliqua*, or the edible spout-fish or razor-fish, and *Mactra stultorum*, or the fool's cockle; both of them molluscs which burrow in the sands above the low-water line of stream tides. The spout-fishes when first thrown ashore were carried away by pail and basketfuls by the poorer people; and yet of their shells enough remained in the space of half a mile to load several carts; but the fishes themselves, devoured by myriads of birds, chiefly gulls, soon disappeared. The mactra, though they may be picked up in some places by basketfuls, are less abundant. It is probable, however, that both species will be less common on our coasts than heretofore, for years to come; and their wholesale destruction by a frost a few degrees more intense than is common in our climate, strikingly shows how simple, by slight changes of climate, induced by physical causes, whole races of animals may become extinct. It exemplifies, too, how destruction may fall upon insulated species, while, from some peculiarity of habitat, or some hardiness of constitution, their congeners escape. There are two species of solen in the Frith, *S. siliqua* and *S. ensis*, but we have not seen, on the present occasion, a single dead individual of the latter species; and of at least four species of mactra, the *Mactra stultorum* seem alone to have suffered.—*Edinburgh Witness.*

WING-RAYS OF INSECTS.

Mr. Newman has read to the Entomological Society a note on the Wing-Rays of Insects, in which the author maintains, in opposition to the published views of Herold, Kirby and Spence, Oken, Westwood, and other distinguished entomologists, that the wing-rays are the supports of the membraneous portion of the wing, and in all respects the analogues, although not the homologues, of the wing-bones of the bat; and that the passage of air, blood, and nerves through their channels is simply a provision of nature for their maintenance in a healthy and efficient condition.

LIGHT FROM THE CENTIPEDE.

A CORRESPONDENT writes from Batheaston, Bath, that observing upon a window-curtain a Centipede, two inches long, to ensure its destruction he put the insect into a vessel of boiling water, when it emitted from its entire body a phosphoric light of a pale violet colour.

THE SILKWORM.

MR. WESTWOOD has exhibited to the Linnean Society some cocoons, and living chrysalides of the Eria Silkworm of India, which feeds on the castor-oil plant, and which he had received from the Governor of Malta, through Dr. Templeton; this being the species, the introduction and cultivation of which, in Malta, Italy, and the south of Europe, was now attracting so much attention in those countries, as proved by the numerous communications presented within the last few months to the Academy of Sciences at Paris, by Marshal Vaillant, French Minister of War, Messrs. Milne-Edwards, Guérin-Méneville, J. Geof. St. Hilaire, Duméril, Montague, &c. An extract was read, communicated by Major-General Hearsey, from the *Journal of the Asiatic Society*, on the peculiarities of the silk of this species of moth, the natural history of which, as well as of the Tusseh silk-moth of India, formed the subject of an excellent memoir by Dr. Roxburgh, in the *Transactions of the Linnean Society*, vol. vii. On examining the cocoons, Mr. Westwood had observed that, unlike those of the common silkworm and most other moths, which were of an entire, oval form, these cocoons were open at one end, which was protected by a series of converging elastic threads (like the mouth of a rat-trap), a peculiarity which had been long observed in the cocoons of the common Emperor moth, *Saturnia pavonia minor*. This peculiarity, which had also been noticed by M. Duméril, had been supposed to have for its object the introduction of air to the interior of the cocoon, and also the prevention of the ingress of parasitic *Ichneumonidæ*, &c. Neither of these theories, was, however, considered by Mr. Westwood as conclusive; he thought rather that it was connected with the discharge of the fluid which most insects emit immediately after arriving at the perfect state. The circumstance is, however, of practical importance in the Eria moth, as it allows the egress of the perfect insect, without injuring the thread of the cocoon, as is the case when the common silkworm moth of the mulberry is allowed to escape from its cocoon. It is, however, not of so great practical importance as might be at first supposed, as the silk-growers never allow the cocoons intended for winding to produce the moth; still, those cocoons which were set aside in order to obtain the perfect insects for breeding from, would also remain uninjured after the escape of the moths.

The Bombyx cynthia, or Eria silkworm, which, after repeated failures, was finally, about two years ago, successfully introduced into Malta from the East Indies, and for the rearing of which it was hoped the climate would have proved peculiarly adapted, has utterly failed; so that the breed, which appears to have degenerated with every successive transmutation, has at last become perfectly extinct, the insect on hatching not having the power to extricate itself from the shell, and dying in the process. This result, in spite of the great care and atten-

tion that has been bestowed upon the propagation of this species of silkworm, is the more to be regretted, since, had the Eria met with in Malta a climate genial to its nature, it might have been the means of introducing into Europe one of the most valuable products of the East Indies; for although up to the present period the mode of reeling these cocoons is yet to be discovered, still it is undeniable that a species which yields from five to seven crops of cocoons in the course of the year, which by the process of maceration are capable of producing a silk of a most beautiful quality, could not but be considered an acquisition of very great value.

M. Guérin-Méneville, who was charged by the Paris Society of Acclimatation to watch carefully over the eclosion of the Oak Silkworms, the eggs of which had been sent some time back from China, has presented a Report on the subject, from which it appears that both males and females had arrived at maturity at Paris and at Turin. Everything leads to the belief that the leaves of the ordinary oak of Europe will serve as food for these worms; but, in addition, the acorns of two kinds of oak growing in China, and much liked by the worms in question, have been brought over and planted. M. Guérin-Méneville has exhibited some pieces of plush of great beauty, made by a manufacturer of Paris from the silk of the oakworms; he also produced some very fine specimens of spun-silk obtained in India from the same kind of worm.

There has been exhibited to the Entomological Society a specimen of silken felt formed by the caterpillars of *Saturnia pavonia media*, which were confined separately in receptacles, presenting no salient points to which the cocoons could be attached, and so the whole stock of silk was spread over the smooth surface. Herr Pretsch states that a series of very interesting experiments with these larvæ is now in progress at Vienna, and promises perfect success.

NEW PAUSSUS.

Mr. A. Murray, in a "Report on the Recent Additions to our Knowledge of the Zoology of Western Africa" (read to the British Association), notes that a single New Paussus has been found. It was on this coast that the first Paussus known was met with. Afzelius was sitting at table in the dusk, when a small insect dropped upon his paper, carrying two globe-shaped antennæ like coach-lanterns on its head, both giving out a feeble light. This was the *Paussus sphærocephalus*. Mr. Westwood has since described a large number of species; and he seems to question the accuracy of Afzelius, so far as regards the light given out by the antennæ, as that has not been observed since, and many of the species have hard and untransparent globes on the antennæ. The globes in Afzelius's species, however, are semi-transparent; and the habit of life of many of them would seem to render their luminosity not improbable, for they live in ants' nests. If it is so, it shows how diversely nature sometimes acts under the same circumstances. Here she provides a light for the darkness; while in

other instances, where species live wholly in the dark, as in the Cave of Carniola, Kentucky, &c., she takes away their eyes altogether as useless appendages.

IMPROVED BEE-HIVE.

MR. DOWNIE has exhibited to the Entomological Society a Bee-hive containing several improvements, the efficacy of which he had proved during three years; consisting, first, of a moveable floor, by means of which the essential matter of removing dead bees, &c., in winter, might be accomplished without admitting cold air; secondly, a series of ventilators to insure the admission of air according to circumstances; and thirdly, an easy method of feeding the bees.

BRAZILIAN ANTS.

THERE have been read to the Entomological Society "A Description of some Species of Brazilian Ants," by Mr. J. Smith, with observations on their economy, by H. W. Bates. Mr. Brayley, referring to the habits of one of the species of ants mentioned in this paper, said that the immense trains of ants carrying the mutilated bodies of various insects, might illustrate the accumulation of insect remains at times seen in the strata of the secondary geological formation; for if these trains had been suddenly covered up, the stratum in which they were embedded would afterwards exhibit the same appearance as the deposits to which he had alluded.

DEATH FROM THE BITE OF THE TARANTULA.

WE find recorded in the *Frontier Times* (Cape of Good Hope paper), an account of the death of the child of Captain Foster, 12th Regiment, a boy seventeen months old, under the following distressing circumstances:—The child was observed to be heavy, and at night fever came on. Next day a slight colourless swelling was noticed above the bend of the left arm, which was painful on being pressed, but on careful examination no marks of injury of any kind could be detected. The fever abated under treatment, but next morning the swelling had considerably increased, and before night had extended down to the hand, up to the shoulder, and over the chest. Convulsions came on at night, followed by difficult respiration, rapid pulse, copious perspirations, and cold surface; and the poor little sufferer expired, under all the symptoms of death by a poisonous bite. Just before death a small bladder appeared in the spot where the swelling was first noticed, which became discoloured and livid; and on examining this vesicle after death, two small punctures could be distinctly seen. Ammonia had been freely administered, but the cause was not suspected until absorption had taken place to such an extent as to render all treatment unavailing. It is supposed to have been the bite of a very venomous species of Mygale (Tarantula), which is common in old thatched houses in Graham's Town—one of which, several inches long, was killed by Captain Foster's English servant in the passage of the house two or three weeks previously.

As it is not perhaps generally known that the bite of the Tarantula of this colony is poisonous, we may mention that the late Dr. J. Atherstone, when practising in Cape Town, was called to attend a strong labouring man, a reaper, in the neighbourhood of Pampoene Kraal (we believe), who, whilst taking up a sheaf of wheat, was bitten by a Tarantula on one of the veins at the back of his hand, and in less than twelve hours the man died. In Graham's Town also, in 1839, Dr. Atherstone attended a carpenter, named Jessamine, who, whilst pulling off some old thatch at Fort England, perceived a large Tarantula in the palm of his hand, which bit him before he could brush it off. He felt a sense of smarting and itching, but no pain in the part, and thought no more of it. In two days, however, the back of his hand began to swell rapidly, the swelling extending up to the shoulder; and although the wound (or rather the spot where he was bitten, for no marks could be perceived) was immediately cut out and cauterized, the whole hand sloughed, exposing the tendons, and he did not recover for eight weeks. Two cases of death from Tarantula bites are also recorded by Dr. Graperon in the *Quarterly Journal of Foreign Medicine* (1, p. 215), as having taken place in the Crimea—one in forty-eight hours, the other in six days; scarification, the actual cautery, ammonia, &c., were all employed in vain.

DEATH BY SNAKE POISON.

The *Ceylon Examiner* mentions the death, from the fangs of a Tic Polanga, of a Cinnamon peeler employed in the Cinnamon-garden of Mr. C. Y. Reid. The man refused to have the punctures excised, and perished some twenty hours after the bite was inflicted.

The only remedy for the bite of the Tic Polanga, or fully grown Yellow Cobra, is the immediate cutting out of the part wounded (Dr. Kinnis, who was bitten in Kandy, in 1838, by a Cobra, in the hand, whilst handling it, saved his life by this means), or the plunging into the punctures of a red-hot needle, bradawl, or the end of a penknife. The Indian Sampoori, or snake-catchers, invariably carry with them a small pan of live charcoal with three or four bits of pointed iron in it, to be ready for use in case of being bitten. It has been erroneously stated that "large doses of arrack, or brandy, will frequently cure the sufferer;" but we have seen many cases of snake bites, to the lethargy and prostration always attending which brandy and arrack would only render a fatal result doubly certain.—*Ceylon Times*, September 14.

NEW ACTINIA.

Mr. E. W. H. Holdsworth has read to the Zoological Society a paper containing "Descriptions of two New Species of Actinia from the south coast of Devon," which he characterized under the names of *Actinia pallida* and *Actinia ornata*. They were found on the rocks near the entrance to Dartmouth Harbour, a part of our western coast which, from its steep rugged character and luxuriant growth of sea-

weeds, presents a fruitful hunting-ground for those in search of marine productions.

NEW SEA ANEMONE.

Mr. E. W. H. Holdsworth has read to the Zoological Society an account of a New Species of Sea Anemone, which he referred to the genus Scolanthus. His specimens were all found near low-water mark, embedded in the fine chalky mud which fills the crevices of the rocks at Seaford, near Beechy Head, their expanded discs being just level with the surface, but so nearly covered that only a faint, star-like outline was visible. On being alarmed, they retire into the mud, their extraordinary powers of inversion enabling them to hide at some little distance below the surface. The body tapers a little posteriorly, and terminates with a rounded base, having a distinct central perforation. When closely contracted, the two ends of the body are nearly alike, and the animal assumes the appearance of a more or less flattened sphere or bead, the resemblance to which is much increased by the terminal orifices. This bead-like form suggested the specific name of *Sphæroides*, which Mr. Holdsworth proposed for the animal.

LIVING TOAD EMBEDDED IN COAL.

We find recorded the discovery of a live Toad by the colliers in the employ of Messrs. William Ackroyd and Brothers, at their new collieries, Morley Main, near Leeds. The Toad was found Embedded in the Coal Strata at nearly eighty yards from the surface, and as soon as it became exposed to the atmospheric air it commenced walking. The toad was jet black when found. It, however, soon began to change colour, when put into water, to a lively yellow, with grey spots, and when the writer of this paragraph saw it, the colour was life-like. The toad had a tail on, some three inches in length. A correspondent of the *Leeds Mercury* calls the discovered animal a frog, and says—"The eyes are very bright, and surrounded with a gold ring. It has four claws on its fore-feet, and five (web-footed) on the hind feet. Its mouth is closed, or firmly shut, but it has two vents, apparently nostrils, on the top of its nose."

ARTIFICIAL PROPAGATION OF SALMON.

Mr. Edmund Ashworth has read to the British Association a paper "On the Artificial Propagation of Salmon at Stormont, near Perth." After giving an account of previous experiments on this subject, the author proceeded:—On the 19th of July, 1853, a meeting of the proprietors on the Tay was held at Perth, for the purpose of considering a letter on the artificial propagation of the salmon, written by Dr. Esdaile. On that occasion, Mr. Thomas Ashworth, of Poynton, explained to the meeting the nature of the operations which had been carried on at Outerard by his brother and himself, and strongly recommended the adoption of similar measures in the Tay, under the direction of Mr. Ramsbottom. The proposals of Mr. Ashworth were agreed to, and a Committee was appointed to fix upon a suitable locality for planting of boxes and construction of ponds. The Earl of Mansfield, who was chairman of the meeting, and who has shewn much interest

in the success of these experiments, gave permission to the Committee to make a selection of any portion of his extensive estates on which to carry out their operations. The situation selected was at Stormontfield Mill, near his Lordship's residence. A gentle slope from the stream which supplies the mill offered every facility for the equable flow of water through the boxes and pond. Three hundred boxes were laid down in twenty-five parallel rows, each box partly filled with clean gravel and pebbles, and protected at both ends with zinc grating to exclude trout and insects. Filtering beds were formed at the head and foot of the rows, and a pond for the reception of the fry was constructed immediately below the hatching ground. On the 23rd of November, 1853, operations were commenced, and by the 23rd of December 300,000 ova were deposited in the boxes. The fish were taken from spawning beds in the Tay. The process of fecundation will best be understood by a quotation from Mr. Ramsbottom's pamphlet, in which he describes the means employed in impregnating the ova at Outerard. "So soon as a pair of suitable fish were captured, the ova of the female was immediately discharged into a tub one-fourth full of water, by a gentle pressure of the hand from the thorax downwards. The melt of the male was ejected in a similar manner, and the contents of the tub stirred with the hand. After the lapse of a minute, the water was poured off, with the exception of sufficient to keep the ova submerged, and fresh water supplied in its place. This also was poured off and fresh substituted previous to removing the impregnated spawn. The ova were placed in boxes as nearly similar to what they would be under the ordinary course of natural deposition as possible, with this important advantage: in the bed of the river, the ova are liable to injury and destruction in a variety of ways; the alluvial matter deposited in time of flood will often bring the ova too deep to admit of the extrication of the young fry, even if hatched; the impetuosity of the streams when flooded will frequently sweep away whole spawning beds and their contents. Whilst deposited in boxes, the ova are protected from injury, and their vivification in large numbers is thus rendered a matter of certainty, and the young fish reared in safety.

On the 31st of March, 1854, the first ovum was observed to be hatched, and in April and May the greater portion had come to life, and were at large in the boxes; in June they were admitted into the pond, their average size being about an inch and a half in length. From the period of their admission to the pond the fry were fed daily with boiled liver, rubbed small by the hand. Notwithstanding the severity of the winter, they continued in a healthy condition, and in the spring of the next year were found to have increased in size to the average of three and four inches in length. On the 2nd of May, 1855, a meeting of the Committee was held at the pond, to consider the expediency of detaining the fry for another year or allowing them to depart. A comparison with the undoubted smelts of the river, then descending seawards, with the fry in the ponds, led to the conclusion that the latter were not yet smelts, and ought to be detained. Seventeen days afterwards, viz., on the 19th of May, a second meeting was held, in conse-

quence of great numbers of the fry having in the interim assumed the migratory dress. On inspection it was found that a considerable portion were actually smelts, and the Committee came to the determination to allow them to depart. Accordingly the sluice communicating with the Tay was opened, and every facility for egress afforded. Contrary to expectation, none of the fry manifested any inclination to leave the pond until the 24th of May, when the larger and more mature of the smelts, after having held themselves detached from the others for several days, went off in a body. A series of similar emigrations took place until fully one-half the fry had left the pond, and descended the sluice to the Tay. It has long been a subject of controversy whether the fry of the salmon assume the migratory dress in the second or third year of their existence. So favourable an opportunity of deciding the question as that afforded by the Stormontfield experiment was not to be overlooked. In order to test the matter in the fairest possible way, it was resolved to mark a portion of the smelts in such a manner that they might easily be detected when returning as grilse. A temporary tank, into which the fish must necessarily descend, was constructed at the junction of the sluice with the Tay; and as the shoals successively left the pond, about one in every hundred was marked by the abscission of the second dorsal fin. A greater number was marked on the 29th of May than on any other day, in all about 1200 or 1300. The result had proved highly satisfactory. Within two months of the date of their liberation, namely, between May 29 and July 31, twenty-two of the young fish so marked when in the state of smelts on their way to the sea were, in their returning migration up the river, recaptured and carefully examined; the conclusions arrived at were most gratifying, and proved what has heretofore appeared almost incredible, namely, the rapid growth of the young fish during their short sojourn in the salt water; this fact may be considered as still further established by observing the increased weight according to date of the grilse caught and examined: those taken first weighed 5 to 5½ lb., then increasing progressively to 7 and 8 lb.; whilst the one captured on 31st of July weighed no less than 9¼ lb. In all these fish the wound caused by marking was covered with skin, and in some a coating of scales had formed over the part. Although twenty-two only are mentioned, the taking of which rests on indubitable evidence, nearly as many more were reported from distant parts; the weights and sizes of these had not been forwarded. The experiment at Stormontfield has afforded satisfactory proof that a portion at least of the fry of the salmon assume the migratory dress and descend to the sea shortly after the close of the first year of their existence; and what is far more important in a practical point of view, it has also demonstrated the practicability of rearing salmon of marketable value within twenty months from the deposition of the ova. A very interesting question still remains to be solved. At what date will the fry now in the pond become smelts? Hitherto, they have manifested no disposition to migrate; and if the silvery coat of the smelt be not assumed till the spring of 1856, a curious anomaly would present itself. Some of the fry as smelts will, for the first time, be descending seawards, of the average weight of

2 oz.; some as grilse will be taking their second departure to the sea; and others still more advanced will even have completed their second migration, and return to the river as salmon 10 or 12 lb. in weight. It is much to be desired that the experiment at Stormontfield could be continued for a year or two longer, till the links in the chain of evidence now wanting to complete the natural history of the salmon should be obtained.

Sir W. Jardine expressed the obligation of naturalists, sportsmen, and epicures to the originators of these experiments. He thought, however, it was most desirable to fix the nomenclature of the young salmon, to abandon the local names of parrs, smelts, smolts, &c., and to adopt one name that should be recognised by naturalists and experimenters all over the country. There seemed now no doubt of the irregularity of the growth of the salmon in its earlier stages. He had himself caught grilses not more than 5 or 6 oz. in weight, but which were perfectly distinguishable from smolts; and in 1832, a very dry year, when no flood occurred in the Tweed to take down the later shoals of smelts, Mr. Selby, of Twisel, had caught grilse of 11 lb. in weight, which he (Sir William) considered to be the fry of that year which had never left the river. But he regarded the irregularity in the growth and in the time of departure of the young salmon as a natural fact, and not merely a circumstance of artificial breeding. Sir Philip Egerton stated that not only did the smolts or parr go down the river and come up as grilse of 4 or 5 lb. weight, but he had seen marked grilse come up the river as salmon, weighing 12 lb. He did not think, however, that salmon when they went down came back any bigger. Mr. Ashworth said he had known salmon to go down weighing 10 lb. and come up weighing 20 lb. Sir Philip Egerton, in reply to an observation made by Dr. Lankester, stated that the subject of legislating for the artificial production of salmon had been very often considered by the Legislature, but the difficulty lay in securing property in the fish produced. The proper place to breed salmon was at the heads of rivers; but as the salmon came up from the sea they would be caught by proprietors lower down, and no benefit accrue to the individuals who bred them. There was no doubt the quantity of salmon might be enormously increased by the process recommended. (See also pp. 208, 209.)

TRANSPARENT FISH.

PROFESSOR KÖLLIKER, of Wurzburg, has exhibited to the British Association "Specimens of a Transparent Family of Fishes, from the Coast of Messina." Although all transparent, they belong to different genera and species. The only fish with which they can be compared is the amphioxus, but this is a cartilaginous fish, whilst these belong to the osseous fishes, and must be placed near the eels. The genera to which they belong are Leptocephalus, Helmicthys, Hioprorus, and Telurus. These fish have not red blood, but blood corpuscles were present. The muscles are perfectly transparent. Their bones are also soft and transparent. The Professor likewise exhibited a new Crustacean Parasite, which he had found parasitic upon a species of fish belonging to the genus Macrurus. He proposed to call the creature by the generic

name Lophura. He also exhibited the male of the Argonaut, which is an eight-armed creature, much smaller than the female. One of its eight arms is enormously enlarged, and retains its life after separation from the body of the animal. It has been described under the name Hectocotylus, and was at one time supposed to be a parasite on the body of the female argonaut.

MANAGEMENT OF AN AQUARIUM.

At the late Meeting of the British Association, Mr. Warrington pointed out that a temperature below 45° destroys many forms of animal life, especially crustacea; whilst a temperature exceeding 60° Fahr. is destructive of both animal and vegetable life. Too great exposure to light is also destructive of creatures kept in the Aquarium.

Dr. Fleming related, in connexion with the subject of keeping animals in sea-water, that he had in his possession an Actinia, originally captured by Sir John Dalyell, that had now been in captivity twenty-eight years.

Mr. J. Price read to the meeting some "Notes on Animals," which consisted principally of directions for aerating the water of the marine aquarium by means of a moving tank, with suggestions for removing putrid matter from the water, &c.

BOTANY.

EFFECTS OF THE WINTER OF 1855 UPON VEGETATION AT ABERDEEN.

Dr. Dickie has read to the British Association some remarks on this subject. The lowest temperature was recorded on the 15th of February, viz., minus 1° of Fahrenheit's thermometer, the mean temperature of the entire month having been 26·8° Fahr. The effect of such severe frost was very considerable on many plants which for several years previously had been in a thriving condition, and were supposed to be sufficiently hardy to be fitted for the garden or the forest. For the details, see the *Athenæum*, No. 1456. The Rev. H. Higgins stated, that the effect of the above severe cold had been to cause many plants to flower and fruit which did not usually do so. He stated that in a briarium, where he was cultivating British mosses, six species of sphagnum had fruited that he had never before seen in fruit. He also observed, that, although it had been anticipated that the severe cold would destroy all insect life, during this summer there had been an unusual number of insects produced. Professor Balfour said, it was a curious fact that our native plants had suffered more than those which were exotic. Mr. N. B. Ward stated, that cold acted upon both plants and animals much more during a wind than when the air was still. Hence, in his cases plants grew much better at the same temperature than in the open air. Mr. Dawson, of Nova Scotia, observed that, in America, winters with alternating frost and thaw were much more destructive of life than continuous cold. Professor Allman gave an account of the effects of cold at Dublin. He thought the same species of plants were more patient of cold in northern than in southern situations. Dr. Fleming drew attention to

a well-known fact, that wind deflected from a wall is much more destructive in its effects than a direct current of air.

GUTTA PERCHA.

MR. JAMES MOTLEY writes, in Hooker's *Journal of Botany*:—"Of the Gutta Percha very small quantities are now brought to Singapore; it has become a manufactured substance. A vast variety of its gum, at various prices, from three to thirty dollars a picul, is brought in by the natives. Some of these are deep red, some quite white, and many of them are hardly coherent, breaking down and crumbling between the fingers. These are cut and broken up, and cleared from the scraps of bark and wood which are generally found among them; they are then boiled in an iron pan with cocoa-nut oil, and stirred until thoroughly amalgamated. This mixture is allowed to cool again, when it is broken up and re-boiled with more oil, sometimes as often as four times, or until the mass acquires a certain tenacity. The good gutta percha, sliced into thin shavings, is then added in greater or less proportion, according to the quality of the basis, and the whole well mixed. The Chinese who do this are very skilful, and manage to produce from a great variety of gums a very uniform article,—wonderfully so, when it is considered that the gum is bought by the merchants in very small quantities at a time as the natives bring it in. . . . . There seems to be a great mystery about the gutta-percha trees. I was in the heart of their country, and yet could get nobody to show me a single tree. I think the fact is, that they have all been long ago cut down within any reasonable distance of the settlements. I saw large quantities of the gum, though none of the best quality, on the Indragiri. I think I can distinguish at least five sorts, which are probably the produce of different trees; or rather five classes of gums, for perhaps the species are many more, yet, though I offered great inducements, I could not get even a leaf. Of course, if I had gone up with time at my disposal, I would have seen the trees in spite of all; for I should have gone into the woods with the collectors, and this I hope some time to be able to do. The Gum Benjamin, another great staple here, I saw collected. The trees are about eighteen inches diameter, with small low buttresses to the roots; these are notched with a chopper, and produce the ordinary quality of the drug. The best, of a light buff colour and dense substance, is procured from wounds in the uncovered larger roots, and the common or Foot Benjamin is procured from the trunk of the tree. The oil of the seeds is valued as an application to boils; it is probably of little use."

Dr. Hugh Cleghorn, of Madras, in a letter to Professor Balfour, states that Colonel Cotton, of the Madras Engineers, had sent him a piece of Gutta Percha from the Wynaad, with a twig of the tree producing it, which is a true Isonandra. It is believed that the tree grows abundantly in Malabar. As telegraphic lines stretch across our peninsula, the importance of the discovery can scarcely be overrated, now that the forests of Singapore are wellnigh exhausted. The Government will take means to preserve a wholesale destruction in the present instance, by making the forest a royalty, or at all events placing the trees under strict conservancy.

CAOUTCHOUC IN SOUTH AMERICA.

CAOUTCHOUC is procured in the Amazon and Rio Negro districts, from various specimens of Siphonia. Spruce noticed seven or eight species which yielded the substance. In the Amazon, India-rubber is called xeringue, which is a corruption of the Portuguese word seringa. The India-rubber collectors are denominated seringueiros. Alum accelerates the coagulation of caoutchouc, while ammonia keeps it in a fluid state. Seringa trees are tapped about Pará during the dry season from June to December. On the Upper Rio Negro and Lower Cassiquiare, the plants which yield the seringa are *Siphonia lutea*, Spr., and *S. brevifolia*, Spr. They are called long-leaved and short-leaved seringa. Their average height is 100 feet. The seringa of Pará is *Siphonia brasiliensis*, Willd. *Siphonia elastica*, Aubl., also yields caoutchouc near the Barra. *Siphonia Spruceana*, Benth., is another caoutchouc tree. It grows about the mouths of the Tapajoz and Madeira. On the Uaupés there are other caoutchouc trees, probably belonging to Sapotaceæ (Micrandra of Bentham). The Rio Uaupés joins the Rio Negro a little north of São Gabriel, and its course is nearly coincident with the actual equator. Many species of ficus and artocarpus also yield caoutchouc in South America. The families of figs and artocarps abound towards the head-waters of the Rio Negro and Orinoco.—Hooker's *Journal of Botany*, July, 1855.

SARSAPARILLA.

THE following is an extract from a letter from Mr. Spruce, dated Rio Negro, February 5, 1855, and appears in Hooker's *Journal of Botany*, August, 1855:—

"Sarsaparilla is growing scarce and difficult to obtain on these rivers, and is now found only at the head-waters of some of the tributaries of the Rio Negro, Orinoco, and Cassiquiare. Lower down the same streams it seems to have been all uprooted. Those who go to gather it must spend four or six months in the forest, and endure all sorts of privations. I have never in the whole course of my wanderings come across one of the species of smilax which affords sarsaparilla of commerce, though I have gathered numerous species of that genus. But, in 1852, I saw plants of a smilax near São Gabriel (and I sent specimens of the leaves and fruit to Kew), which had been brought from the Canabrís, and from which I saw the roots extracted and dried for sale.

"Those who go to collect sarsaparilla tell me they are guided by three characters:—

1. Many stems from a root.
2. Prickles of stem closely set.
3. Leaves thin (not coriaceous).

"I am assured that the species of smilax possessing these characters united have also numerous long roots, radiating horizontally from the crown; while the single-stemmed species have only a solitary tap-root.

"I am aware that the Jamaica sarsaparilla is said to command a better price in the market than that of Pará, but I thought it had

been planted in that island. Of the sarsaparilla collected in the upper tributaries of the Orinoco, of the Rio Negro, the greater portion goes to the Pará market, where it fetches a better price than at Angostura. I am not aware that it enters into the commerce of any other port in Venezuela except Angostura; and it is curious if the same sarsaparilla coming to England by way of Jamaica sells for double the price that it fetches when sent by way of Pará."

DECAISNEA.

Dr. T. Thomson has read to the Linnean Society a paper by Dr. J. D. Hooker and himself on "Decaisnea," a remarkable genus of *Lardizabaleæ*. This interesting plant, which was originally discovered in Bhetan, by the late Mr. William Griffith, and subsequently met with by Dr. Hooker in Sikkim, is briefly referred to by Griffith, in his *Itinerary Notes*, under the name of *Slackia insignis*. That name, however, having, before the publication of these *Itinerary Notes*, been applied by Griffith himself to a genus of palms, Drs. Hooker and Thomson propose to designate the genus *Decaisnea*, after M. J. Decaisne, the author of an admirable treatise on the "Lardizabaleæ," the small but singular natural order to which it belongs. The plants of this order are very generally characterised by the distribution of the ovules over the whole surface of the ovaries, as well as by their more or less digitate leaves. The genus *Decaisnea*, however, differs from its allies in having simply pinnated leaves, and in the disposition of its ovules; these are arranged in a double series, along elevated lines, on each side of the ventral suture of the ovaries, which are externally very similar to those of *Holboellia*. The ripe fruit is a large and agreeably flavoured pulpy follicle, dehiscing along the ventral suture, and disclosing to view the shining dark brown or blackish seeds. It is an erect shrub, with large leaves, and bearing elongated terminal racemes of greenish white flowers, slightly tinged with purple, closely resembling those of other *Lardizabaleæ*. It inhabits the eastern Himalaya, at an elevation of six to ten thousand feet.

ON BEECH-OIL.

Amongst the various kinds of Oil used in Northern Germany, especially the kingdom of Hanover, for culinary purposes or as materials of combustion, that extracted from the nuts of the Beech (*Fagus sylvatica*, Linn.) is, on account of its numerous good qualities, deserving of notice. Beech-oil does not play a prominent part in commerce, nor is it likely to do so, owing to the fact that it cannot be procured in large quantities; the country-people who collect the nuts, or cause them to be collected, use the greater part of the oil extracted from them in their own household, and only dispose of the remaining fraction. This is the reason why it is impossible to give even a rough estimate of the quantity annually produced. About Hanover the nuts are gathered towards the end of October, or the beginning of November. This is done either by picking up by hand those which have fallen to the ground, or by spreading out large sheets under the trees and beating the branches with poles, so as to cause the nuts to separate from them.

The latter process appears, at first sight, the least expensive; but as the good nuts have to be separated from the bad (abortive) ones, it is found on closer examination to be just the contrary. In 1854, about 25 lbs. of nuts sold in Hanover for eighteenpence; 25 lbs. yield about 5 lbs. of oil, 1 lb. selling for about sevenpence. The oil is of a pale yellow colour, and has an extremely agreeable taste. It is often adulterated with walnut-oil; the latter is even sold as beech-oil, and that may account for the difference of opinion entertained respecting the quality of the beech-oil. The townspeople use it chiefly as salad oil, but the peasantry employ it generally as a substitute for butter, &c., and only when there has been a good harvest of nuts, for burning in their lamps. The husks are, after the oil has been expressed, made into cakes about nine inches square and one and a half inch thick; these are used for fuel, and not given, as some people imagine, as food to cattle. — *Wilhelm E. G. Seeman, in Hooker's Journal of Botany*, June 1855.

CHINESE VEGETABLES.

Mr. Henderson, the well-known agriculturist, has published a work upon the Chinese potato, *Discorea batatas*. The plant, he says, is not liable to disease, and yields twenty-four tons to the acre. It appears, too, that a highly nutritious pea from China has been tried in France, and with marked success; and the Chinese sugar-cane is found to grow well in Belgium, and produce, as is estimated, 100 gallons of cider to the acre, and a large amount of fibre fit for the manufacture of paper. The Geographical Society of Paris has given one of its medals to Monsieur Montigny, consul at Shanghae, as a reward for his having sent over the potato above mentioned, with some other useful plants, and the oak silkworm.

PLANTS FOR PAPER MANUFACTURE.

The following memoir "On Papyrus Bonapartea and other plants, which can furnish Fibre for Paper Pulp," has been read to the British Association by the Chevalier de Claussen, who commences by explaining what the paper manufacturers want.

They require (says the author) a cheap material, with a strong fibre, easily bleached, and of which an unlimited supply may be obtained. I will now enumerate a few of the different substances which I have examined for the purpose of discovering a proper substitute for rags. Rags containing about 50 per cent. of vegetable fibre, mixed with wool or silk, are regarded by the paper-makers as useless to them, and several thousand tons are yearly burned in the manufacture of prussiate of potash. By a simple process, which consists in boiling these rags in caustic alkali, the animal fibre is dissolved, and the vegetable fibre is available for the manufacture of white paper pulp. Surat, or jute, the inner bark of corchorus indicus, produces a paper pulp of inferior quality, bleached with difficulty. Agave, phormium tenax, and banana or plantain fibre (Manilla hemp), are not only expensive, but it is nearly impossible to bleach them. The banana leaves contain 40 per cent. of fibre. Flax would be suitable to replace rags in paper manufacture, but the high price and scarcity of it, caused partly by the War,

and partly by the injudicious way in which it is cultivated, prevents that. Six tons of flax straw are required to produce one ton of flax fibre, and, by the present mode of treatment, all the woody parts, or shoves, are lost. By my process, the bulk of the flax straw is lessened by partial cleaning before retting, whereby about 50 to 60 per cent. of shoves (valuable cattle food (are saved, and the cost of the fibre reduced.

By the foregoing it will be seen that the flax plant only produces from 12 to 15 per cent. of paper pulp. All that I have said about flax is applicable to hemp, which produces 25 per cent. of paper pulp. Nettles produce 25 per cent. of a very beautiful and easily bleached fibre. Palm-leaves contain 30 to 40 per cent. fibre, but are not easily bleached. The bromeliaceæ contain from 25 to 40 per cent. fibre. Bonapartea juncoides contains 35 per cent. of the most beautiful vegetable fibre known. It could not alone be used for paper pulp; but for all kinds of manufactures in which flax, cotton, silk, or wool are employed. It appears that this plant exists in vast quantities in Australia; and it is most desirable that some of our large manufacturers would import a quantity of it. The plant wants no other provisionary preparation than cutting, drying, and compressing like hay: the bleaching and finishing of it may be done here. Ferns give 20 to 25 per cent. fibre; not easily bleached. Equisetum from 15 to 20 per cent. inferior fibre, easily bleached. The inner bark of the limetree (tilea) gives a fibre easily bleached, but not very strong. Althea and many malvaceæ produce from 15 to 20 per cent. paper pulp. Stalks of beans, peas, hops, buck-wheat, potatoes, heather, broom, and many other plants, contain from 10 to 20 per cent. of fibre, but their extraction and bleaching present difficulties which will probably prevent their use. The straws of the cereals cannot be converted into white paper pulp after they have ripened the grain; the joints or knots in the stalks are then so hardened that they will resist all bleaching agents. To produce paper pulp from them they must be cut green before the grain appears, and this would probably not be advantageous. Many grasses contain from 30 to 50 per cent. of fibre, not very strong, but easily bleached. Of indigenous grasses, the ryegrass contains 35 per cent. of paper pulp, the thalasis 50 per cent., arranatherium 30 per cent., and dactylis 30 per cent., carex 30 per cent. Several reeds and canes contain from 30 to 50 per cent. of fibres easily bleached. The top of the sugar-cane gives 40 per cent. of white paper pulp.

The wood of the coniferæ gives a fibre suitable for paper pulp, as I discovered when making flax-cotton in my model establishment at Stepney. I remarked that the pine-wood vats in which I bleached were rapidly decomposed on the surface into a kind of paper pulp. I collected some of it, and showed it in the Great Exhibition; but as at that time there was no want of paper material, no attention was paid to it. The leaves and top branches of Scotch fir produce 25 per cent. of paper pulp; and sawdust, the shavings of wood from Scotch fir, give 50 per cent. pulp. The cost of reducing to pulp and bleaching pine-wood will be about three times that of bleaching rags.

As none of these substances or plants would entirely satisfy on all points the wants of the paper-makers, I continued my researches, and

at last remembered the papyrus (the plant of which the ancients made their paper), which I examined and found to contain about 40 per cent. of strong fibre, excellent for paper, and very easily bleached. The only point which was not entirely satisfactory was relative to the abundant supply of it, as this plant is only found in Egypt. I directed, therefore, my attention to plants growing in this country, and I found, to my great satisfaction, that the common rushes (juncus efusus, and others,) contain 40 per cent. of fibre quite equal, if not superior, to the papyrus fibre, and a perfect substitute for rags in the manufacture of paper, and that one ton of rushes contains more fibre than two tons of flax straw.

ALOE-WOOD, OR ALOES OF SCRIPTURE.

THIS fragrant wood appears to be produced by *Aquilaria Agallochum*. The tree is called in Hindi and Bengali, Aggur, Agar, or Uggor; it is also denominated Ûd, and the Arabic name is Aghaluji. Sanscrit writers give three varieties of Aloe-wood—1. Aguru, the common sort; 2. Cálâguru, or black aloes, being of a darker colour than the common kind; 3. Maugalyá, or Maugalyagura, having the fragrance of the Mallica or Jasminum Sambac. The name Agallochum appears not to be derived from the Arabic, nor from the Hebrew Ahalim and Ahaloth; but from the Indian name Agaru, or with the Sanscrit pleonastic termination *ca*, Aguruca. It may be stated that the Portuguese Pao de Aquila, as noticed by Rumphius, is an undoubted corruption of the Arabic Aghâluji and the Latin Agallochum; and it is by a ludicrous mistake that from this corruption has grown the name Lignum Aquilæ, whence the genus of the plant now receives a botanic appellation, and which many authors have vainly attempted to distinguish from the Lignum-Aloes and Calambac. The generic and specific names of this plant are thus both drawn from the same original term.—*Colebrooke, in Linnean Transactions*, xxi.

ORIGIN OF THE CULTIVATED WHEAT.

MUCH interest has been excited of late by the statements of M. Fabre and M. Dunal, who affirm that the Cultivated Wheat (*Triticum sativum*) is a variety of a grass called *Ægilops ovata*, found in the south of Europe. This grass, under cultivation, is said to assume the form called *Ægilops triticoides*, and finally to become wheat. M. Fabre says that the complete change was produced in twelve years by constant cultivation. If this view is correct, then botanists are wrong in supposing wheat to be a *Triticum*, and it must be regarded merely as a *sport* of *Ægilops*, kept up entirely by the art of the agriculturist. We do not see common wheat in a wild state, but we meet with the grass whence it is derived. Wheat would seem to be a variety rendered permanent by cultivation. These opinions of Fabre have been supported by strong evidence. Of late, however, M. Godron has published a paper in the *Annales des Sciences Naturelles*, in which he maintains that *Ægilops triticoides* is not a mere *sport* of *Ægilops ovata*, but that it is a hybrid between the cultivated wheat and the latter plant. This statement seems, at all events, to confirm the idea that wheat and the Ægilop are nearly allied plants, for hybrids are not easily produced

except between plants which resemble each other closely. This would be the first known instance of a hybrid among grasses. There can be no doubt that the wheat and Ægilops ovata are congeners, and that they exhibit evident marks of resemblance in the form of their caryopsis. There appears, therefore, to be much plausibility in the statement of Fabre, and the hybridization spoken of by M. Godron may be merely such as would occur between varieties of the species. The matter is therefore by no means settled, and further experiments are required.—*Edinburgh New Philosophical Journal*, No. 2.

WELLINGTONIA GIGANTEA.

Dr. Torrey has recently had an opportunity of counting the circles in a complete radius of the trunk of the famous Wellingtonia, now exhibited at New York, and he finds that they are 1120 in number. From the data furnished by Dr. Torrey, we learn that, on the radius examined, the

	Inches.		Inches.
First 100 circles occupy a breadth of	17½	Seventh 100 circles occupy a breadth of	7¾
Second do.	14	Eighth do.	11
Third do.	12¼	Ninth do.	10
Fourth do.	13	Tenth do.	11
Fifth do.	16½	Eleventh do.	11½
Sixth do.	8¾	The remaining 20 layers	1

There are 1120 circles in a semi-diameter of 135 inches, or 11 feet 3 inches. The facts show that the tree lacks about three centuries of being half as old as it was said to be. Its enormous size is owing rather to its continued rapid growth. Gray thinks that there is no adequate specific difference between Wellingtonia and Sesquoia, and that the tree must henceforth be called Sesquoia gigantea.—*Silliman's American Journal*, Vol. 18.

TRUFFLES.

The art of producing Truffles, which has long been sought for, but always without success, has (says the *Union*) been discovered. M. Rousseau, a wealthy inhabitant of Carpentras, instead of attempting to cultivate the plant itself, thought he might produce it by cultivating the tree, a certain description of oak, around which it is chiefly found. He, therefore, about eight years ago, planted a number of acorns from that species of oak, and they sprung up and are flourishing. He recently commenced his propagating truffles beneath the young oaks, and has obtained a large quantity of excellent quality.

An interesting paper on Truffles and Truffle-hunting has lately appeared in Dickens's *Household Words*.

POISON OF THE MONKSHOOD.

About two years ago, a gentleman was accidentally poisoned in Bristol, by eating scrapings of the roots of the Wolf's Bane, or Monkshood (*Aconitum napellus*), in mistake for horseradish. From a recent Number of the *Chemist*, it appears that Mr. Thornton Herapath has subjected

several specimens of these roots, collected at different periods of the year, to a chemical analysis, and has thus ascertained that the highest proportion of poisonous alkaloid (aconitine) they contain amounts to about a grain and a half in a thousand grains, or more exactly, 10·12 grs. per lb. From these results, and the evidence given at the inquest, Mr. Herapath has satisfied himself that the gentleman in question must have been poisoned by a quantity of aconitine, certainly not exceeding five one-hundreths of a grain in weight. Consequently, the poison of the monkshood is the most deadly poison known, not even excepting prussic acid. Aconite roots, Mr. Herapath says, may be readily distinguished from those of horseradish, by the scrapings of the former rapidly assuming a pinkish brown colour on exposure to the air.

FORMATION OF ASCIDIA.

Dr. Balfour, in observations read by him to the Botanical Society of Edinburgh, states that he was induced to make some remarks on the Formation of Ascidia in consequence of seeing lately a statement to the effect that all pitchers were formed by a hollowing out process. He was disposed to think that *true Ascidia*, such as those of Nepenthes, Sarracenia, Cephalotus, and Heliamphora, were formed by folded leaves in the same way as carpels are supposed to be produced. The anomalous ascidiform productions on the leaves of cabbage, lettuce, &c., might be traced to a similar process, and in some instances the pitcher-like body appeared to be a second leaf folded in an opposite manner from that from which it sprung. Occasionally two or more leaves formed ascidia. What has been called the "hollowing out process" is applicable to such cases as Eschscholtzia, Myrtaceæ, Rose, Hovenia, &c. This hollowing out process caused a development of the circumference of the receptacle, peduncle, or other part, while the central portion was undeveloped, and thus there arose a cup-like body with a hollow centre. In such instances there seemed to be a union, in the early state, of the circumferential cellular papillæ arising from the peduncle or receptacle, or other part; these became elongated, so as to form a gamophyllous rim of greater or less depth, enclosing a hollow space in which certain organs were developed. The pitcher-like peduncle or receptacle was often connected with the calyx, and was lined by cellular matter in the form of a disc.

RARE BRITISH FERN.

Mr. Ward, F.L.S., has exhibited to the Linnean Society two sets of specimens of a rare British Fern (*Asplenium lanceolatum*, Huds.), from Jersey, with the view of exemplifying the effect of light upon this tribe of plants. Both sets of specimens were found growing upon disintegrated sandstone, and under precisely similar circumstances, with the single exception that one set had been grown upon a sunny bank, the other under dense shade; the former being small and stunted, while the latter had become so much larger and more luxuriant that they might almost have been taken for different species. Dr. J. D. Hooker and Dr. Robert Wight made some observations upon the effects of different degrees of light and shade, together with the corresponding changes in the dryness or moisture of the atmosphere, in modifying the

characters of plants, and suggested that many so-called species would eventually prove to be mere varieties, or forms, resulting from such causes.

THE VINE DISEASE.

MR. J. J. FORRESTER has communicated to the Royal Society a paper "On the Vine Disease in the port-wine districts of the Alto-Douro, in April, 1854," with proposed remedies for its eradication.

Taking into consideration all the circumstances narrated in this paper, Mr. Forrester concludes that the *oïdium* is the *cause* and not the *effect* of the disease; that the inclemency of the season in 1853, by checking the circulation of the sap in the vines, produced a predisposition for disease; that if the *oïdium* continues to appear on the branches of the vines, it is only too probable that it may in a very few years be destroyed; that the *globules* are a sign of health and not of disease, and have no connexion whatever with the fungus called *oïdium;* and that if the germ of the *oïdium*, probably still lurking on the old branches, can be destroyed in the open air as effectually as it appears to have been destroyed under glass, then all the vines in the port-wine districts of the Alto-Douro may be saved.

The remedies proposed for the eradication of the vine-malady are:—

1st. Take the annual production of wines in the port-wine districts of the Alto-Douro at 80,000 pipes instead of 90,000, and the number of vines to be treated as diseased at 80,000,000.

2nd. The value of freehold land in that district, for the growth of 1000 vines, or one pipe of wine, may be estimated at 50*l.*, yielding an interest or rental of 3*l.* per annum.

3rd. The total freehold value of the vineyards in those districts may be estimated at 4,000,000*l.* sterling, giving an annual revenue of 240,000*l.*

4th. In the event of the disease not being checked in its progress, and the grapes being destroyed this year in the Alto-Douro, a *minimum* loss of 240,000*l.* will be sustained, and should the vines perish, the loss may be 4,000,000*l.*

5th. Portugal is said to produce annually 1,000,000 pipes of wine of all sorts and qualities; but estimate the total production at 800,000 pipes, and the total number of vines in the country at 800,000,000.

If *Flour of Sulphur* be used, the leaves, branches, and shoots are first moistened as equally as possible with a syringe; then the whole is dusted with sulphur, which adheres to the moistened surface.

This operation would have to be repeated thrice, and would consume two ounces of sulphur for every vine, in each of the operations, making a total of 480,000,000 ounces, or about 13,392 tons for the treatment of the 800,000,000 vines in the Alto-Douro, and 133,920 tons for the vines of the whole country.

Sulphur would not cost less than 10*l.* per ton, delivered in the centre of the Alto-Douro districts, or in any other part of the interior of Portugal. The expense of sulphur required for the Douro would be 133,920*l.*, and for the whole country 1,339,200*l.*

One man could moisten one vine in one minute, and another man could dust it with sulphur in the same time, so that two men could

perform the complete operation on about 700 vines daily, at a cost of 1*s*. 3*d*. each man for labour, making a total of 14,285*l*. in the Alto-Douro, and 142,850*l*. for all Portugal.

Suppose that there are 4000 vineyards in the Alto-Douro, planted each with 20,000 vines. The first cost of syringes and fumigators would amount to not less than 10*l*. for each vineyard, or a total of 40,000*l*. for the Alto-Douro.

One quart of water would be required for every vine in each operation, making a total of about 90,000 pipes, the cartage of which, and the labour of distributing it over the mountain vineyards, in tubs, on men's heads, would cost a minimum of 10*s*. per pipe, or a total of 45,000*l*. for the Alto-Douro, and 450,000*l*. for the whole country. The following is the recapitulation:—

	In the Douro.	In the whole country.
For sulphur, say	£135,000	£1,350,000
For labour, at £15,000 for each of the three operations	45,000	450,000
For water, at £45,000 for each of the three operations, or as much as the sulphur	135,000	1,350,000
For instruments	40,000	400,000
	£355,000	£3,550,000

This is independent of any charge for factors or superintendents, or for the extra expense in treating vines and vineyards which are so much further apart than are those in the Alto-Douro.

This expense to be incurred *in the endeavour* to save *one year's crop*, would be equal to a charge of 4*l*. 10*s*. per pipe, or to a *year and a half's rental* of the vineyards, or to more than the whole revenue of Portugal for an entire year.

CHINESE METHOD OF SCENTING TEAS.

THE following very interesting letter upon this subject has appeared in the *Athenæum*, No. 1447:—

"I have been making inquiries for some time past about the curious process of scenting teas for the foreign markets; but the answers I received to my questions were so unsatisfactory, that I gave up all hopes of understanding the business until I had an opportunity of seeing and judging for myself. During a late visit to Canton I was informed the process might be seen in full operation in a tea factory on the Island of Honan. Messrs. Walkinshaw and Thornburn, two gentlemen well acquainted with the various kinds of teas sent annually to Europe and America, consented to accompany me to this factory, and we took with us the Chinese merchant to whom the place belonged. I was thus placed in a most favourable position for obtaining a correct knowledge of this curious subject. When we entered the tea factory, a strange scene was presented to our view. The place was crowded with women and children, all busily engaged in picking the stalks and yellow or brown leaves out of the black tea. For this labour each was paid at the rate of six cash a catty, and earned on an average about sixty cash a day—a sum equal to about threepence of our money. The scene

altogether was not unlike that in the great Government Cigar Manufactory at Manilla. Men were employed giving out the tea in its rough state, and in receiving it again when picked. With each portion of tea a wooden ticket was also given, which ticket had to be returned along with the tea. In the northern tea countries the leaves are carefully weighed when they are given out and when they are brought back, in order to check peculation, which is not unfrequent. I did not observe this precaution taken at Canton. Besides the men who were thus employed, there were many others busily at work, passing the tea through various sized sieves, in order to get out the caper, and to separate the various kinds. This was also partly done by a winnowing machine, similar in construction to that used by our farmers in England. Having taken a passing glance at all these objects on entering the building, I next directed my attention to the scenting process, which had been the main object of my visit, and which I shall now endeavour to describe.

"In a corner of the building there lay a large heap of orange-flowers, which filled the air with the most delicious perfume. A man was engaged in sifting them, to get out the stamens and other smaller portions of the flower. This process was necessary, in order that the flowers might be readily sifted out of the tea after the scenting had been accomplished. The orange-flowers being fully expanded, the large petals were easily separated from the stamens and smaller ones. In 100 parts, 70 per cent. were used and 30 thrown away. When the orange is used, its flowers must be fully expanded, in order to bring out the scent; but flowers of jasmine may be used in the bud, as they will expand and emit their fragrance during the time they are mixed with the tea. When the flowers had been sifted over in the manner described, they were ready for use. In the meantime, the tea to be scented had been carefully manipulated, and appeared perfectly dried and finished. At this stage of the process it is worthy of observing, that while the tea was perfectly *dry* the orange flowers were *just as they had been gathered from the trees*. Large quantities of the tea were now mixed up with the flowers, in the proportion of 40 lb. of flowers to 100 lb. of tea. This *dry* tea and the *undried* flowers were allowed to lie mixed together for the space of twenty-four hours. At the end of this time the flowers were sifted out of the tea, and by the repeated sifting and winnowing processes which the tea had afterwards to undergo, they were nearly all got rid of. Sometimes a few stray ones are left in the tea, and may be detected even after it arrives in England. A small portion of tea adheres to the moist flowers when they are sifted out, and this is generally given away to the poor, who pick it out with the hand.

"The flowers, at this part of the process, had impregnated the tea leaves with a large portion of their peculiar odours, but they had also left behind them a certain portion of moisture, which it was necessary to expel. This was done by placing the tea once more over slow charcoal fires, in baskets and sieves prepared for the purpose of drying. The scent communicated by the flowers is very slight for some time, but like the fragrance peculiar to the tea-leaf itself, comes out after being

packed for a week or two. Sometimes this scenting process is repeated when the odour is not considered sufficiently strong; and the head man in the factory informed me he sometimes scented twice with orange-flowers, and once with the 'Mo-le' (*Jasminum Sambac*).

"The flowers of various plants are used in scenting by the Chinese, some of which are considered better than others, and some can be had at seasons when others are not procurable. I considered it of some importance to the elucidation of this subject to find out not only the Chinese names of these various plants, but also by examining the plants themselves, to be able to give each the name by which it is known to scientific men in all parts of the world. The following list was prepared with great care, and may be fully relied upon. The numbers prefixed express the relative value of each kind in the eyes of the Chinese, and the asterisks point out those which are mostly used for scenting teas for the foreign markets:—

1. Rose, scented (Tsing-moi-qui-hwa).
1 or 2. Plum, double (Moi hwa).
2*. Jasminum Sambac (Mo-le hwa).
2 or 3*. Jasminum paniculatum (Sieu-hing-hwa).
4*. Aglaia odorata (Lan-hwa, or Yu-chu-lan).
5. Olea fragrans (Kwei hwa).
6*. Orange (Chang hwa).
7*. Gardenia florida (Pak-sema hwa).

It has been frequently stated that the Chloranthus is largely used. This appears to be a mistake, originating, no doubt, in the similarity of its Chinese name to that of *Aglaria odorata*. The Chloranthus is called 'Chu-lan;' the Aglaia 'Lan,' or 'Yu-chu-lan.'

"The different flowers which I have just named are not all used in the same proportions. Thus, of Orange flowers there are 40lb. to 100 lb. of tea; of Aglaia there are 100 lb. to 100 lb.; and of *Jasminum Sambac* there are 50lb. to 100lb. The flowers of the Sieu-hing (*Jasminum paniculatum*) are generally mixed with those of the Mo-le (*Jasminum Sambac*) in the proportion of 10lb. of the former to 30lb. of the latter, and the 40 lb. thus produced are sufficient for 100 lb of tea. The 'Qui-hwa' (*Olea fragrans*) is used chiefly in the northern districts as a scent for a rare and expensive kind of Hyson Pekoe,—a tea which forms a most delicious and refreshing beverage when taken *à la Chinoise*, without sugar and milk. The quantity of flowers used seemed to me to be very large; and I made particular inquiries as to whether the teas that are scented were mixed up with large quantities of unscented kinds. The Chinese unhesitatingly affirmed that such was not the case, but notwithstanding their assertions, I confess I have some doubt on this point.

"The length of time which teas thus scented retain the scent is most remarkable. It varies, however, with the different sorts. Thus, the *Olea fragrans* tea will only keep well for one year; at the end of two years it has either become scentless, or has a peculiar oily odour, which is disagreeable. Teas scented with orange-blossoms and with those of the Mo-le will keep well for two or three years, and the Sieu-hing kinds for three or four years. The Aglaia retains the scent longer than any, and is said to preserve well for five or six years. The tea scented with

the Sieu-hing is said to be most esteemed by foreigners, although it is put down as second or third rate by the Chinese.

"Scented teas for the foreign markets are nearly all made in Canton, and are known to merchants by the names of 'Scented Orange Pekoe,' and 'Scented Caper.' They are grown in and near a place called Tai-shan, in the Canton Province. Mr. Walkinshaw informs me that other descriptions of tea, both black and green, have been scented for the English market, but have been found unsuitable. True 'caper' is to black tea what the kinds called 'imperial' and 'gunpowder' are to green: it assumes a round, shot-looking form, during the process of manipulation, and it is easily separated from the other leaves by sifting or by the winnowing-machine. It is a common error to suppose that 'imperial' or 'gunpowder' amongst green teas, or 'caper' amongst black ones, is prepared by rolling each leaf singly by the hand. Such a method of manipulation would make them much more expensive than they are. One gathering of tea is said to yield 70 per cent. of orange pekoe, 25 of souchong, and 5 of caper. The quantity of true caper would therefore appear to be very small; but there are many ways of increasing the quantity by peculiar modes of manipulation.

"In a large factory, such as this at Canton, there is, of course, a considerable quantity of dust and refuse tea remaining after the orange pekoe, caper, and souchong have been sifted out of it. This is sold in the country to the natives at a low price, and no doubt is often made up with paste and other ingredients into those *lie teas* which now-a-days find a market in England. Nothing is lost or thrown away in China. The stalks and yellow leaves which have been picked out by women and children are sold in the country; while the flowers which have done their duty in the scenting process are given to the poor, who pick out the few remaining tea-leaves which had been left by the sieve or winnowing machine. Some flowers, such as those of the aglaia, for example, after being sifted out from the tea, are dried and used in the manufacture of the fragrant 'joss stick,' so much used in the religious ceremonies of the country.

"It appears from these investigations that many kinds of fragrant flowers besides those used by the Chinese would answer the purpose equally well; therefore, in places like India, where tea is likely to be produced upon an extensive scale, experiments in scenting might be made with any kinds of jasmines, daphnes, aurantiaceous, or other fragrant plants indigenous to the country."

SAPONACEOUS PLANTS.

The Chevalier de Claussen has read to the British Association a paper "On the Employment of Algæ and other Plants in the Manufacture of Soaps." The author accidentally treated some common seaweeds with alkalies, and found they were entirely dissolved, and formed a soapy compound which could be employed in the manufacture of soap. The making of soap directly from sea-weeds must be more advantageous than burning them for the purpose of making kelp, because the fucaloid and glutinous matter they contain are saved and converted into soap. The Brazilians use a malvaceous plant (sida) for washing, instead of soap.

TREE WITHIN THE ARCTIC CIRCLE.

SIR EDWARD BELCHER has read to the British Association the following "Remarks on the Trunk of a Tree discovered erect as it grew within the Arctic Circle, in 75° 32′ N., 92° W., or immediately to the northward of the Narrow Strait which opens into the Wellington Sound." Having dispatched several shooting parties, said Sir Edward, in quest of hares and ptarmigan, one commanded by the boatswain returned about midnight, on the 12th of September, 1853, bringing a report that they had discovered the heel of the topgallant-mast of a ship in an erect position, about one mile and a half inland; and the carpenter's mate, one of the party, asserting that it was certainly a "worked spar," of about eight inches diameter, seemed to confirm this report. Such a communication from such authorities, and considered of sufficient importance to awaken me, startled me not a little. One point, however, was not so clear to my imagination—it was too far inland, and, moreover, in a hollow. On the morrow I proceeded, accompanied by the boatswain, armed with picks and crows, to search for and bring in this discovery; but it was not without great difficulty that it was re-discovered, snow having nearly obliterated the foot-marks of the previous day. I at once perceived that it was not a mast, nor a worked spar, nor placed there by human agency. It was the trunk of a tree that had probably grown there and flourished, but at what date who would venture to determine? At the period when whales were thrown up and deposited, as we found them, at elevations of 500 to 800 feet above the present level of the sea, and the land generally convulsed, and also when a much higher temperature prevailed in these regions, this tree probably put forth its leaves, and afforded shade from the sun. Such a change of climate just then would have been peculiarly acceptable! I directed the party which attended me to proceed at once to clear away the soil, then frozen mud, and splintering at every effort like glass. The stump was at length extracted, but not without being compelled eventually to divide the tap root; and collecting together the portions of soil which were immediately in contact, and surrounding the tree, in the hope of discovering impressions of leaves or cones, the whole was carefully packed in canvas, and eventually reached this country. Near to the spot in question, I noticed several peculiar knolls, from which I was led to infer that other trees had grown there; I caused them to be dug into, but they proved to be peat mosses, about nine inches in depth, and, on closer examination in my cabin, proved to contain the bones of the lemming, in such extraordinary quantity as to constitute almost a mass of bony manure.

Through the kindness of Dr. Hooker, the entire matter having been forwarded to Sir W. Hooker, at Kew, I am enabled to furnish the following interesting remarks:—"The piece of wood brought by Sir Edward Belcher from the shore of Wellington Channel belongs to a species of pine—probably to the *Pinus* (*Abies*) *alba*, the most northern conifer. This, the "white spruce," advances as far north as the 68th parallel, and must be often floated down the great rivers of North America to the Polar Ocean. The structure of the wood of the specimen brought home differs remarkably in its anatomical characters from

that of any other conifer with which I am acquainted. Each concentric ring (or annual growth) consists of two zones of tissue; one, the outer, that towards the circumference is broader, of a pale colour, and consists of ordinary tubes of fibres of wood marked with discs common to all coniferæ. These discs are usually opposite one another when more than one row of them occur in the direction of the length of the fibre, and, what is very unusual, present radiating lines from the central depression to the circumference. Secondly, the inner zone of each annual ring of wood is narrower, of a dark colour, and formed of more slender woody fibres, with thicker walls in proportion to their diameter. These tubes have few or no discs upon them, but are covered with spiral striæ, giving the appearance of each tube being formed of a twisted band. The above characters prevail in all parts of the wood, but are slightly modified in different rings; thus the outer zone is broader in some than in others, the disc-bearing fibres of the outer zone are sometimes faintly marked with spiral striæ, and the spirally marked fibres of the inner zone sometimes bear discs. These appearances suggest the annual recurrence of some special cause that shall thus modify the first and last formed fibres of each year's deposit, so that that first formed may differ in amount as well as in kind from that last formed, and the peculiar conditions of an arctic climate appear to afford an adequate solution. The inner or first formed zone must be regarded as imperfectly developed, being deposited at a season when the functions of the plant are very intermittently exercised, and when a few short hours of hot sunshine are daily succeeded by many of extreme cold. As the season advances, the sun's heat and light are continuous during the greater part of the twenty-four hours, and the newly-formed wood fibres are hence more perfectly developed; they are much larger, present no signs of striæ, but are studded with discs of a more highly organized structure than are usual in the natural order to which this tree belongs.

INFLUENCE OF LIGHT ON THE GERMINATION OF PLANTS.

Dr. Daubeny has given to the British Association an account of some experiments on the Germination of Seeds, the object of which was to determine whether the opinion, that this process is most favoured by the chemical rays of light, be well founded or otherwise. Five sets of experiments were instituted for this purpose, in each of which from forty to sixty seeds, of several different kinds, were exposed to the action of light transmitted through different media. In a south aspect, indeed, light, which had passed through the ammonio-sulphate of copper, and even darkness itself, seemed more favourable than the whole of the spectrum; but this law did not seem to extend to the case of seeds placed in a northern aspect, where the total amount of light was less considerable. Nor did there appear to be any decided difference in those cases where the *band* of light was different, the quantity transmitted being nearly the same. From these experiments Dr. Daubeny deduces the conclusion, that light only affects germination in so far as it induces a degree of dryness unfavourable to the process; and this he believes to be accordant with the experience of maltsters.

Geology and Mineralogy.

FOSSILS IN BERKSHIRE.

PROFESSOR OWEN has read to the Geological Society the following "Description of a Fossil Cranium of the Musk-buffalo (*Bubalus moschatus*, Owen; *Bos Pallasii*, De Kay; *Ovibos Pallasii*, H. Smith and Bl.), from the Gravel at Maidenhead, Berks." This specimen was discovered by the Rev. Mr. Kingsley and Mr. J. Lubbock in a gravel-pit close to the engine-house at the Maidenhead station last summer, and is the first example of the subgenus *Bubalus* yet recognised as fossil in Britain. It consists of the cranial part of the skull, with the horn-cores, nearly perfect. The Professor, in describing this fossil, first offered his reasons for regarding the so-called "Musk-ox" as having been unnecessarily separated from the Buffaloes, and then gave an account of the few fossil skulls of the Musk-buffalo yet known, viz., those figured by Pallas, Ozeretskowsky, and Cuvier. A comparison was then made of the fossil remains with recent crania; and, although the skulls somewhat differ in a few points, especially in the relative curvatures of the horn-cores, yet the author was led to conclude that, as far as the materials for comparison at his command would serve, the differences between the fossil and recent musk-buffaloes are not of specific value; that the *Bubalus moschatus* of the Arctic regions, with its now restricted range, is the slightly modified descendant of the old companion of the Mammoth and the Tichorine Rhinoceros, which with them enjoyed a much wider range, both in latitude and longitude, over lands that now form three divisions or continents of the northern hemisphere; and that the circumstances which have brought about the probably gradual extinction of the northern rhinoceros and elephant have not yet effected that of the contemporary species of Arctic buffalo.

Mr. J. Prestwick, Sec. G.S., then read the following "Note on Gravel near Maidenhead, in which the remains of Musk-buffalo were found." From Maidenhead to the sea, a distance of 50 miles, the valley of the Thames is occupied with a mass of ochreous gravel, from 5 to 15 feet thick, and varying from two or three miles to eight or nine miles in width. This gravel is composed of subangular chalk-flints, derived from the chalk of the adjacent district, together with flint pebbles derived from the tertiary strata, and pebbles of quartz and old rocks derived from the conglomerates of the New Red Sandstone. There are also a few fragments of Oolitic rocks and of the Lower Greensand. Land shells and bones of land animals have been found in this gravel at several detached localities, as at Brentford, Kingston, London, &c. The date of the deposition of the mammaliferous gravel is, in the author's opinion, probably posterior to that of the boulder-clay of Norfolk and Suffolk, and necessarily posterior to the gravel which caps the chalk plateau traversed by the valley at Maidenhead. This latter, or "high-level," gravel is very similar in its lithological character to that in the valley, or the "low-level" gravel. The "low-level" gravel at Maidenhead rests on chalk-rubble; and the skull of the Musk-buffalo

was found, together with fragments of other bones, low down in the gravel, where it begins to be mingled with the chalk-rubble.

STRUCTURE OF THE GLOBE.

MR. HOPKINS has read to the British Association a paper "On the Meridional and Symmetrical Structure of the Globe, its Superficial Changes, and the Polarity of all Terrestrial Operations." Mr. Hopkins's paper was illustrated by maps and diagrams, including a section, on a large scale, of the Cordilleras, from the plains of the river Meta to the shores of the Pacific Ocean. Amongst other speculations, Mr. Hopkins said that 9000 years ago, the site on which London now stands was in the torrid zone; and, according to perpetual changes in progress, the whole of England would in time arrive within the Arctic circle. Mr. Hopkins's views were, however, very warmly controverted by Professor Ramsay and Professor Nicholl.

NEW GEOLOGICAL MAP.

M. DUMONT, the celebrated geologist, completed for the recent Paris Exhibition a Geological Map of Europe. Maps of this nature have previously appeared, but of a special and limited character; and M. Dumont, taking advantage of the numerous documents with which he has been readily furnished by the scientific world in general, has succeeded in completing a work destined to be of the utmost importance in the classification of the various compositions which form the soil of Europe. M. Dumont has also placed at the disposal of the Academy a map, to be published by Government, showing the subsoil of Belgium. The former exposes with the greatest accuracy the surface of the soil, but the present work is destined to reveal what lies below the more recent deposits, thus affording most valuable indications in the research of minerals or building materials, as also to agriculturists. A map of the environs of Spa, Theux, and Pepinster has also been laid down by the same eminent geologist, whose various works cannot fail to conduce as well to his own reputation as to the honour of the university of Liege.—*Brussels Herald.*

GEOLOGY OF THE CRIMEA.

A CORRESPONDENT of the *Illustrated London News*, after stating that the above has been well described by M. Du Bois de Montpéreux, by M. Huot, in the work of Démidoff, and in the *Geology of Russia and the Ural Mountains*, by Sir Roderick Murchison and M. de Verneuil, proceeds to observe that the most ancient deposits of the Crimea are those belonging to the Jurassic group, forming the mountain-chain which presents on the sea-coast steep cliffs of limestone based on schists, and much perforated by eruptive rocks, green stones, porphyry, &c. This chain runs in a direction E.N.E. to W.S.W., its culminating point being Tchatir Dagh, or the Tent Mountain, 5135 feet elevation. In lithological character, the Jura of the Crimea and the Caucasus represents, like that of Russia, the Terrain Oxfordien, or Middle Oolite of English geologists. It is to this series, no doubt, the limestones belong, alluded to by the Correspondent of the *Times* as being used in

the formation of the new road, by Mr. Doyne, round the base of Frenchman's-hill, which he speaks of as being formed of *hard carboniferous limestone*—strata which would be considerably lower in the series, and do not occur at all in the Crimea or its immediate neighbourhood.

The "Neocomien," or Lower Greensand, may be well observed in the Crimea at the foot of the chain towards the north, its horizontal beds resting unconformably upon the Jurassic limestome. Above this, the Upper Cretaceous series occur, consisting of shales, upper greensand, chalk marl, and white chalk, as in the Caucasus.

Next in ascending order is the Nummulitic formation, now included in the Eocene, or Older Tertiary Division (so named from its containing vast masses of lenticular bodies called nummulites, from their resemblance to coins), and much used as a building stone at Simpheropol and Sebastopol. Nearly all these rocks are of much harder and more crystalline character than their equivalents in Northern Europe.

Eruptive rocks frequently intervene, the effect of some of which upon the Jurassic limestone may be well seen near the Monastery of St. George.

The Older Caspian, or Steppe limestone, with sands, &c., occupies the northern and greater portion of the peninsula, including the Heracleotic Chersonese; and is the upper shelly limestone of Eupatoria, Sebastopol, &c. It also includes the chief limestones round Kertch, and the deposits of the cliffs of Kamiesch Boroun, and Taman, also the limestones on the northern and western shores of the Black Sea. These limestones and sands, associated in parts with volcanic ashes, tufa, &c., are much softer than the rocks which constitute the chief ridges; they occur in various conditions, and are more or less fossiliferous, being largely used as a building stone in the east of Europe. The oolitic character of some varieties has doubtless led to the mistake of comparing it with the Secondary Oolites of the neighbourhood of Stroud in Gloucestershire.

The Newer Caspian occurs at the still more northern extremity of the Crimea, extending to Perekop, Kherson, and the shores of the Sea of Azoff.

The sides of the Bay of Sebastopol develop a succession of formations from the most recent of these Tertiaries, through the Steppe limestone, Nummulitic limestone, and Chalk—the Bay of Sebastopol having been excavated in the Jurassic or more ancient formation.

THE LATE SIR HENRY DE LA BECHE.

At the Annual General Meeting of the Geological Society, on February 16, the President announced the award of the Wollaston Palladium Medal to Sir H. T. De la Beche; in the absence of whom, on account of ill-health, the President placed the Medal in the hands of Sir R. I. Murchison; and, addressing Sir Roderick, first briefly alluded to the geological writings of Sir H. de la Beche, and he dwelt particularly upon Sir Henry's great merits in having been the

chief author and promoter of the establishment of the Museum of Practical Geology, and of a School of Mines, on an enlarged and liberal scale. He also particularly alluded to the Geological Survey of Great Britain and Ireland, based on the Ordnance maps, and of which Sir Henry had the superintendence; mentioning the skill and impartiality Sir Henry had shown in the choice of an able staff of naturalists, geologists, palæontologists, chemists, and mineralogists, who had assisted him in this great national work. The President likewise alluded to the success attending the establishment of lectures in that museum for the purpose of teaching the application of geology and the kindred sciences to agriculture and other purposes. In returning thanks in the name of his friend, Sir H. De la Beche, Sir R. Murchison fully pointed out the progress of Sir Henry's success in the establishment of the Museum of Practical Geology; and particularly observed that the noble building in Jermyn-street, constructed in great measure from the designs of the Director himself, to the imperishable credit of its author, stands forth as the first palace ever raised from the ground in Britain, which is entirely devoted to the advancement of science. Sir Roderick referred to the vast importance of the cultivation of the science of geology, and the arts of mining and metallurgy in countries so rich in mineral produce as Great Britain, her colonies, and her dependencies. He remarked that the School of Mines is admirably adapted to meet the requirements; that Sir Henry himself and many of his best officers, who have with him laboured in the formation and support of this institution, have sprung from the body of this society; that, bound by such ties of relationship, the Geological Society should use its best endeavours to have this noble and useful institution maintained by the British Government in that high position to which it has been raised; and that it is the duty which this society owes to science and the public to see that this institution, though it naturally branches off into highly useful and collateral subjects of art, be never rendered subsidiary to them, but be permanently and independently sustained on its own solid basis of science. This our view, said Sir Roderick, will also be taken, I feel confident, by every enlightened statesman who may be placed in a station to enable him to provide for the future wellbeing of the admirable museum founded and completed by our Wollaston medalist.—*Literary Gazette*, No. 1990.

[We regret to add that Sir Henry De la Beche died on April 13, in his fifty-fifth year. Never has the scientific world had to deplore the loss of a more amiable man.]

NEW WORK BY AGASSIZ.

The announcement of the intended publication of Agassiz's great work on the Natural History of this country (the United States), has called forth the universal sympathy of literary and scientific men with the object aimed at in this grand enterprise, and the author has been warmly applauded by the press for undertaking so great a work. Already, though the price of the work will be necessarily high, and the publication extended over many years, several hundred names

have been received. His friends have been especially active in the State of Massachusetts. In New Bedford alone as many as sixty copies have been subscribed for. The Smithsonian Institute has not only subscribed for fifteen copies, but has offered to distribute among its correspondents 2000 copies of the prospectus issued by the author, together with a circular letter from Professor Henry. The *Boston Transcript* says that Professor Agassiz is not less astonished than gratified at what has been done and is doing, and is now writing to Humboldt and other great men of science in Europe, to astonish them also; and to teach the world, through them, that the people of these United States know as well how to appreciate and support science, as how to acquire wealth and power, to secure private rights and reward industry, to promote education, and to maintain the rights and the honour of their country.—*American Literary Gazette.*

GLACIAL PHENOMENA OF THE LAKE DISTRICT OF ENGLAND.

MR. JAMES BRYCE has read to the British Association a paper on this subject, in which he pointed out the peculiar geological structure of the district, illustrated by a coloured map. There are three gigantic districts encircled by slate of three different ages, the granites and slates being all very distinct, and easily recognised when found at a distance. These rocks are found to be transported to great distances, in various directions, across valleys and over high ridges; the cause adequate to produce the phenomena is a matter still in dispute among geologists. In order to elucidate, if possible, this obscure subject, Mr. Bryce has carefully examined the many mountain-valleys radiating in all directions from the high mountains of the Great Jabel, and finds various evidences of the former action of glaciers in all these valleys. They seem to have descended from a nucleus in the higher districts of the mountains, to have filled the valleys, and spread out over the low country at the base, all round the Lake District. In confirmation of this view, various arguments were stated.

GLACIAL PHENOMENA IN PEEBLES AND SELKIRK SHIRES.

MR. ROBERT CHAMBERS, in a paper read to the Royal Society of Edinburgh, has presented facts, from which he thought himself entitled to infer that the Silurian mountain tract of southern Scotland falls entirely into his views regarding ancient glacial operations in the country generally, as expounded in a paper read to the Royal Society of Edinburgh, in December, 1852, and published in No. 2 of the *Edinburgh New Philosophical Journal.* He showed that the compact boulder clay, which he regards as the detritus of the early and general *glaciation* of the country, exists in the valleys of this district, and in passes amongst the hills, up to those of Glenlude and Tweedshaws, which are respectively 1152 and 1352 feet above the mean level of the sea. Striated boulders from Glenlude and Tweedshaws were brought before the Society. The rounded form of the hills, and the horizontal *mouldings* or *flutings* which are seen along the faces of many of them, he considers as other memorials of the operations in question. The nature of the rocks is unfavourable for the preservation of smooth or

striated surfaces; but Mr. Chambers found one such on the border of St. Mary's Loch, in Selkirkshire, 800 feet above the sea. On the assumption that the hills had been shorn and rounded by moving ice, it appeared from the high inclination of the strata, as exhibited in a copy of Professor Nichol's section of the district, that the amount of denudation fully equalled the remarkable examples adduced by Professor Ramsay in regard to South Wales and the Mendip Hills. Finally, Mr. Chambers described an example of the later and limited operations of ordinary glaciers in the elevated moor of Loch Skene, a tarn formed and retained by a moraine.—*Edinburgh New Philosophical Journal*, No. 3.

ON THE OCCURRENCE OF GLACIERS AND ICEBERGS DURING THE PERMIAN EPOCH. BY PROFESSOR RAMSAY, F.G.S.

THE conclusions arrived at in this paper were made in July, 1854, during an examination of the Permian Breccias, near Enville, in South Staffordshire, on the Clint Hills and Bromsgrove Lickey, and on the Abberley and Malvern range. These rocks consist of transported fragments, of various sizes, imbedded in a hard, red, marly paste. They are generally angular or subangular, a well-rounded pebble being of rare occurrence. The larger fragments vary from one to four feet in diameter, and they consist of pieces of altered slate, green and purple slate, sandstone, conglomerates, black and blue slate, greenstones, felstones, felspathic ash, &c.; all lithologically distinct from any of the rocks in their neighbourhood, and apparently identical with the rocks of the Longmynds and the Lower Silurian country east of the Stiper Stones. Pieces of Caradoc limestone, having all the peculiarities, both zoologically and lithologically, of the rock of that country, are also common. Many of the stones have their sides somewhat flattened, and others are polished and more or less marked by striæ, undistinguishable in general character from some moraine fragments of existing Alpine glaciers, or from the ancient moraines of the Vosges, the Scotch Highlands, Ireland, and Wales, or from the scratched fragments in the pleistocene drift. It was argued that, from their angularity, their size, and the distances they had travelled (fifty miles in many cases), they could have been transported only by icebergs, which descended from the Longmynds and the Welsh border; and, breaking off at the sea-level, floated hither and thither, and deposited their freights in the Permian Sea. A fault of from 2000 to 3000 feet throws down the Longmynd country on the west, so that the present relative elevation of these rocks to the Permian breccia gives no clue to their ancient physical relations; more especially as, even without the fault, a mere tilting of the ground to the extent of 2° or 3° would make a difference of several thousand feet in their relative heights.

It was also argued that the Permian fauna and flora afford no argument against the glacial character of a small part of the Permian epoch: first, because that fauna and flora are not at all essentially tropical in their nature; and, secondly, because there is no *à priori* reason why there might not be a glacial episode during Permian ages, as in Tertiary times, that comparatively so nearly approach our own; for if the

crag and all the pleistocene beds and the deposits now forming were thrown as far back in time, solidified, and highly disturbed, we should certainly, because of their fauna, include them all in one geological epoch; yet in the midst of that period, in the British area we have had glaciers with great moraines, and drifting icebergs scattering clay and boulders in the lowlands of England. It was further argued, that the radiation of heat from the interior of the globe has not affected external climates since the earliest fossiliferous epochs; and, though climates have changed, this must be referred to some other cause: for the melting-point of ordinary lava is about 19·34° Fahr.; and assuming the increment of heat to be about 1° Fahr. for every 60 feet of depth, the temperature of rocks would rise to 19·34° Fahr. at 116,000 feet beneath the surface; and rocks might at least be metamorphosed when long subjected to so great heat. The present external effect of internal temperature is estimated at one-twentieth of a degree Fahr.; but to affect external climate 1° Fahr., the descending rate of increase must have been about 20° Fahr. for every 60 feet, and the equivalent temperature of the surface melting-point of lava would be reached at a depth of 5864 feet. In North Wales, there are in place at least 32,000 feet of conformable Silurian and Cambrian strata, which, except that they are hardened and cleaved, have only in rare places undergone any high degree of alteration. This would not have been the case had the rocks in general attained the melting-point of lava at a depth of only 5864 feet; even then, the increment of internal temperature would be too small to affect the external climate, so as to give it a character at all approaching tropical heat.—*Literary Gazette*, No. 1992.

CRETACEOUS ROCKS AND FOSSILS IN NATAL.

There has been read to the Geological Society a "Notice of Cretaceous Rocks in Natal," by Captain R. J. Garden, communicated by Mr. R. Godwin Austen, F.G.S. The discovery of these fossiliferous rocks near the Umtafuna river, on the coast of South Africa, was made by Mr. H. F. Fynn in 1824. About three miles to the southward of the river commence certain excavations in the cliffs, formed by the action of the sea, and called by the natives "white men's houses." The caves extend about 800 yards. Captain Garden collected a suite of fossils from the walls of the caves and from the adjoining cliffs. Fossil trees are seen at low-water on a reef of flat rocks near these caverns. Half-a-mile beyond the caves, the Umzambani river is crossed by the fossiliferous strata, which, in Captain Garden's opinion, extend probably as far as the Umtata river.

In a series of fossils Mr. Baily has recognised—one shark's tooth (*corax*); some bones of a chelonian; five species of cephalopods; eleven species of gasteropods; and nineteen species of lamellibranchiates. Of the molluscs, thirty are previously undescribed forms, and are related to, or bear a close affinity with, cretaceous species. There is but one species, however, which can be positively identified with any English fossil, and that is *Pecten quinquecostatus*, one of the most characteristic of cretaceous species. Of the gasteropods, a *Scalaria* is closely related to a cretaceous species found in the gault of Folkstone and the greensand

of Blackdown. Two *Turritellæ* also are allied to cretaceous forms from France. The genera of bivalves in this collection are all known in cretaceous or older strata; the majority being characteristically cretaceous. One species of echinoderm is a characteristic cretaceous form of the genus *Hemiaster*. Some of the univalves, it may be remarked, present close resemblances to those of the cretaceous beds of Pondicherry, Southern India.

GEOLOGY OF NATAL.

DR. P. C. SUTHERLAND, in letters to Sir R. Murchison, says:—Sandstone and shale, alternating with and traversed by trap rocks, constitute the main features of the Natal district, and form table-hills of considerable elevation and extent. Impressions of leaves and stems, together with saurian bones, are found in the sandstone and shale, which also contain thin seams of coal, some of which are worked to supply the colony with fuel. The sandstones are occasionally overlaid by volcanic rock (trachyte), inclosing fragments of the older rocks, which has scored and grooved the underlying surface. A huge dyke of porphyritic granite traverses the country from north-east to south-west. The author also noticed the sand-dunes blown up on the coast by the wind, and hardened into a building-stone by infiltration of carbonate of lime in solution. This stone contains the fragmentary sea-shells blown up with the sand, as well as perfect land-shells which lived among the bush on the sand-hills. The copper ore of Natal appears to be a malachite diffused through contorted gneiss rock, having a sienite character.—*Literary Gazette*, No. 2000.

FOLIATED ROCKS OF NORWAY.

MR. D. FORBES has read to the Geological Society a paper upon this subject. The author commenced with remarks as to the directions taken by the lines of foliation, and some cases were brought forward where the foliation appeared to coincide with the true bedding; this, however, was not considered as necessarily the case. Other instances were alluded to, where the foliation appeared to be independent of the cleavage. The mechanical origin of cleavage was strongly insisted upon. Cleavage was considered as distinct from foliation; in support of which opinion, numerous cases and specimens were shown in illustration of foliation having been induced by minerals not usually present, and the presence of which was only to be accounted for by chemical action. Remarks were made as to the arrangement of foliation, and as to the temperature at which foliation had taken place. Appearances in rocks were cited as opposed to the view that foliation had been produced by a fusion or semi-fusion of the rocks. This was further illustrated by specimens showing the experimental production of rocks similar to gneiss, chloriteschist, &c., by prolonged heating at temperatures below fusion or softening. Remarks on the chemical composition of these rocks in relation to the other sedimentary formations were made; and the author, in conclusion, considered that this communication would be confirmatory of the following views:—1. That foliation and cleavage are two distinct processes, not necessarily connected; and that those cases where we find them identical or parallel,

result from foliation having been induced subsequently to cleavage. 2. That foliation is the result of chemical action, combined with a simultaneous arranging molecular force, generally developed at temperatures below the fusion or semi-fusion of the rocks; also that, when we find rocks which we know have been previously in a fused state possessing a foliated structure, this structure has been induced subsequently to their solidifiation. 3. That the arrangement of foliation may often be due to the intrusion or approach of igneous rocks, with a tendency to follow the direction of the lines of least mechanical resistance in the rocks themselves, whether these lines be lines of cleavage or of stratification, or the striæ resulting from movement in fusion. 4. And lastly, that there is considerable reason to suppose that the foliated rocks may have been altered fossiliferous strata, from their chemical composition, the presence of certain minerals, and the changes known to take place in other fossiliferous rocks.

ON THE PALÆOZOIC ROCKS OF THE THURINGERWOLD AND THE HARZ.

SIR RODERICK MURCHISON has communicated to the Geological Society a memoir by himself and Professor Morris, "On the Palæozoic Rocks of the Thüringerwold and the Harz," the chief object of which was to compare those chains of Central Germany, by showing the peculiarities of each, and by indicating how they differed from or agreed with the Silurian basin on the east, and the Devonian rocks of the Rhenish provinces on the west. Their relation to British rocks of the same age was also explained in a large tabular view. The Thüringerwold was first described as containing a considerable portion of the most ancient sedimentary strata which are unknown in the Harz; viz., hard quartzose and slaty grauwacke, void of animal remains, followed upwards by grey slates, sandstones, conglomerates, and partial limestones, the age of which is clearly Lower Silurian, as proved by the genera and species of Trilobites, Orthis, Orthoceratites, and Graptolites which they contain. These masses, which occur in the Southern Thüringerwold only, are at once overlapped by strata of Upper Devonian age, to the exclusion of the Upper Silurian, so finely developed near Prague, and of the Middle and Lower Devonian (Spirifer Sandstone and Eifel Limestone) of the Rhenish Provinces. Characterized by numerous species of Clymeniæ and Godiatites, as well as by an abundance of Cypridinæ and very peculiar land plants, these limestones and schists pass up into other deposits, chiefly sandstones, which clearly belong to the Lower Carboniferous division, as proved by their imbedded plants, and by their containing, in adjacent tracts, products of the mountain limestone as well as partial layers of coal. All these ancient German strata, from the lowest sediments to the millstone grits of English geologists inclusive, have been thrown into highly inclined positions, and constitute, as a whole, those "Grauwacke" rocks of old geologists, which have been separated by modern researches into distinct natural history groups. Whilst the inclined edges of the older rocks are here and there surmounted by thin coal-bearing courses (Kohlen Gebirge), the chief overlying formations constitute the Permian of Murchison—the base of which, the Rohte-todteliegende (Angl.

Lower Red Sandstone); the middle, the copper slate and Zechstein, with their well known fossils (Magnesian Limestone of England); and its summit, sandy shale and marlstone. In the Harz there are no clear evidence of the same fundamental rock, and no trace of the Lower Silurian, as in Thüringerwold; certain slight indications of the Upper Silurian being doubtful. On the other hand, we there meet with clear evidences of the Lower and Middle Devonian, which, unknown in Bohemia, Saxony, and the Thüringerwold, are so typical of the Rhenish provinces. The Upper Devonian is followed in the Harz by a copious development of the Lower Carboniferous, which, as shown by Professor Sedgwick and Sir Roderick Murchison, in 1839, is the real equivalent of the earlier series of Devonshire, and in parts of which fossils, both animal and vegetable, are not unfrequent. Like the Thüringerwold, the Harz is enveloped by a girdle of Permian rocks, whose lower member in each chain is associated with much porphyry, the evolutions of which, with its accompanying piles of sediment, have obscured the original strike of the older rocks, from north-east to south-west, and have produced transverse axes or watersheds, the geographical direction of the Thüringerwold being from north-west to south-east, and that of the Harz from west-north-west to east-south-east. These and other views, which cannot be adverted to in an abstract, were elucidated by sections and fossils, and by references to the works and maps of contemporary German authorities. In conclusion, the attention of British geologists was called to the great rupture between the Lower and Upper members of the Carboniferous rocks, which, prevailing throughout Germany and France, is unknown in England. The memoir terminated by showing that, notwithstanding the marked discrepancies in mineral composition, in formations of the same age in different localities, the omission of deposits in one track which are seen in another, and numerous breaks and disturbances which have extended over large areas, the geologist accustomed to view nature on a great scale, could only consider the mere local phenomena; since, in spite of all such obscurities, he had no insuperable difficulty in determining, by their imbedded fossils, whether these dislocated or insulated masses belonged to the Silurian, Devonian, Carboniferous, or Permian period of the primæval world.

ENGLAND'S MINERAL WEALTH.

On the authority of Mr. R. Hunt, the Government Keeper of Mineral Records, according to the *Mining Journal*, the following statement is regarded as a near approximation towards the annual value of our mineral wealth:—Coal, as raised at the pit's mouth, 11,000,000*l.*; iron, 10,000,000*l.*; copper, 1,500,000*l.*; lead, 1,000,000*l.*; tin, 400,000*l.*; silver, 210,000*l.*; zinc, 10,000*l.*; salt, clays, &c., 500,000*l.*; giving the enormous total of 24,620,000*l.* This is the value of the raw material. When the cost of labour employed in converting this mass of matter into articles of utility or objects of ornament is added, it will be swelled a hundredfold.*

* See also *Year-Book of Facts*, 1855, page 270.

CRUSTACEANS IN UPPER SILURIAN ROCKS.

THERE has been read to the Geological Society a "Description of the Crustaceans from the Uppermost Silurian Rocks near Lesmahago," by Mr. John W. Salter, F.G.S. The large crustacea referred to in the last paper were described by Mr. Salter. They belong to the family *Eurypteridæ* of Burmeister, and bear the closest relation to *Eurypterus.* They also present many analogies with the *Pterygotus*, particularly in the presence of a scale-like sculpturing on the body-rings, a character now known to be present in *Eurypterus*, and probably common to the whole family.

UPPER SILURIAN ROCKS OF SCOTLAND.

A PAPER has been read to the Geological Society, "On the Discovery, by Mr. Robert Slimon, of Uppermost Silurian Rocks and Fossils near Lesmahago, in the south of Scotland, with Observations on the Relations of those Strata to the overlying Palæozoic Rocks of that part of Lanarkshire," by Sir R. I. Murchison. The principal object of the author is to direct the attention of geologists to the recent discovery of the Uppermost Silurian Rocks of Scotland, in which country their presence was unknown. This important discovery was made by Mr. Robert Slimon, of Lesmahago, who, in the western part of that extensive parish of Lanarkshire, detected very remarkable and large fossil crustaceans, the exhibition of which, at the Glasgow Meeting of the British Association, induced Sir R. I. Murchison to visit the tract in question, accompanied by Professor Ramsay. The descending order of the strata is well seen on the banks of the Nethaw river, Logan water, and other small streams; all tributaries of the Clyde. There the lower carboniferous rocks, composed of several bands of Productus and Encrinite lime-stone, frequent seams of coal and layers of iron-stone, including the celebrated "black band," are underlaid by the Old Red Sandstone, as largely exposed between Lanark and Lesmahago. Towards its lower part the Old Red is marked by a powerful band of peebly conglomerate; whilst its base is made up of alternating red and light greenish-grey flagstones and schists. The latter are succeeded by dark grey, slightly micaceous, flag-like schists, charged with large crustaceans and other fossils, which organic remains, combined with the apparently comfortable infraposition of the beds to the lowest Old Red, having led the author unhesitatingly to consider the Lanarkshire strata to be the equivalents of the uppermost Ludlow rock, or the Tilestones of England. These dark grey fossiliferous layers are underlaid by, and pass down into, a thick accumulation of similar mudstones, which becoming in some parts slightly calcareous, in others arenaceous, rise up into a district of round-backed moorland hills, ranging in height from 1600 to 2000 feet above the sea; the whole tract having been much penetrated by porphyries and other igneous rocks. The uppermost Silurian rock of Lanarkshire contains a species of Pterygotus not to be distinguished from the species of that crustacean so abundantly found in the upper Ludlow rock of Shropshire and Herefordshire; like which the Scotch stratum holds the *Lingula cornea* and *Trochus helicites?* (*Sil. Syst.*) The Lesmahago deposit is further characterized by the crustaceans of the group of Eurypteridæ (Burmeister), which are described by Mr.

Salter under the name of Himantopterus. They are accompanied by another crustacean, the Ceratiocaris. In conclusion, Sir Roderick pointed out the remarkable persistency of this zone of large crustaceans in various parts of the world; one of the Lanarkshire individuals has a length of about three feet! In Westmoreland (Kendal) the Eurypterus is found in the Tilestones, with many upper Ludlow fossils; in Podolia the stratum containing the *Eurypterus tetragonophthalmus* (Fischer) underlies Devonian rocks; and in the Russian Baltic island of Oesel, it has recently been detected by M. Eichwald in a limestone which had been referred by the author and his associates to the Ludlow rock. In North America the Eurypterus occupies the same geological horizon as in Russia and the British Isles; and it is to be remembered that large crustaceans of this group of the Eurypteridæ have nowhere been found in rocks of older date than the Upper Silurian.

A "Description of the Crustaceans from the Uppermost Silurian Rocks near Lesmahago," by Mr. W. J. Salter, was then read; and next, a note by Mr. Huxley, "On the Relations of these Gigantic extinct Crustacea," showing that their zoological position was neither among the Phyllopods nor the Pœcilopods, nor intermediate between the Copepods and Isopods, as had been supposed, but that their structural peculiarities were to be paralleled only among the Cumoid Stomapods on the one hand, and the zoæform larvæ of the Macrura on the other. Drawings of a new genus of Cumoid crustacea, Calyptoceros, illustrated this position; and leaving out of consideration the Isopoda, Pœcilopoda, and Trilobita, it was shown that the Eurypteridæ exhibited the most rudimentary and larval forms of any known Crustacea.—*Athenæum*, No. 1468.

COPPER IN NATAL.

DR. P. C. SUTHERLAND, with a letter addressed to the late Professor E. Forbes, has sent some specimens of Copper Ore from this colony. They occur between the junction of highly contorted and almost vertically placed strata of the crystalline metamorphic rocks, with beds of non-fossiliferous sandstone, which not unfrequently pass into conglomerate on the one side, and into shale on the other. The sandstone strata are nearly 1000 feet thick, are very rarely changed more than 10° to 15° from the horizontal line, and are frequently interstratified with beds of greenstone and basalt and other rocks of the trap series, which are often found decomposed into the greyish-yellow clay. In nearly the same geological position with the copper ore, masses of a species of talcose rock occur, and are found, although not with the copper, passing into rocks of a more stratose character, which, in one or two instances, show an approach to a slightly fibrous structure, not unlike Asbestus. Dr. Sutherland has sent also specimens of what appears to be olivine, from the same locality as the copper ore, but not near the gneiss. The presence of olivine among the granites found here may perhaps lead to giving it a place among rocks esteemed to be of earlier date than those which disturb the sandstone and other strata. It is very abundant among the gneiss strata of the colony. By a rough analysis of the copper ore, Dr. Sutherland found

that some of the average specimens yielded 15 per cent. of the green carbonate (malachite) or 8 per cent. of pure copper.

GOLD-BEARING DISTRICTS OF THE WORLD.

MR. E. HOPKINS, in a paper read to the British Association, has given the results of his observations on the Auriferous Districts of the world, in which he stated that Gold was found only in the primary rocks, and chiefly in quartz, because, when the gold was precipitated, as it were, in nature, the quartz was that with which its particles most readily mixed. Gold might be found in all primary rocks of a meridional structure, where crystalline sands predominate. It was a curious fact that gold might often be found at the roots of large trees, because the roots having assimilated to its nourishment the other materials, left the gold as an indigestible surface behind.

GOLD IN AUSTRALIA.

PROFESSOR NICOL has read to the British Association a paper "On the Auriferous Quartz Formation of Australia," by Mr. J. A. Campbell. The author is of opinion that the gold fields are inexhaustible, and the finding of gold only in its infancy. Boundless fields lie still untouched, which will employ the labour of ages yet to come, and when efficient machinery shall have been brought to operate upon the rocks, there may be then gold enough to liquidate the national debt. Sir R. I. Murchison said he had been in communication with the Governor of Australia, and it was undoubted that, though the population had of late largely increased, the produce of gold had decreased. It was a virgin country; the gold lay in great troughs; and the question was, how long it would take to exhaust them. It might be a quarter of a century—more or less—he would not like to name it; but it would be, sooner or later, exhausted. The riches were on the surface. When the Spaniards first visited South America, and found the palace of Montezuma and the other princes covered with gold, which had been collected by the poor people with their sticks out of the gravel of the earth, they said, "What will come when we go down to the bowels of the earth?" and it must be remembered that the Spaniards were then the best miners in the world. What was the result? They mined for gold—they were ruined; and a proverb gradually came into use, which said, "He who wants to make a fortune will mine for copper; he who wants a moderate fortune will mine for silver; and he who wants to ruin himself, let him mine for gold." There may be exceptions to this rule, but it generally holds true. In nineteen cases out of twenty, deep mining will cost 25*s*. for every 1*l*. of gold. This was undoubtedly the case in South America. No doubt, however, Australia will produce gold for many years, and enable this country to found there a magnificent empire.

GOLD-BEARING VARIETIES OF PRIMARY ROCKS.

MR. EVAN HOPKINS has read to the Institution of Civil Engineers a paper "On the Vertical Structure of the Primary Rocks, and the general character of their Gold-bearing varieties." The author com-

menced by stating, that it was almost impossible to form a correct idea of the true character and geological position of the gold-bearing rocks, without being first acquainted with the symmetrical order of the crystalline structure of the fundamental series; hence the cause why the two subjects were combined in the paper.

The primary laminated rocks, the gneiss, micaceous schists, &c., usually represented in geological sections as layers, or stratified beds, were shown, by numerous illustrations and observations made in different parts of the world, to be always found more or less on edge, presenting a symmetrical structure, very different to the sedimentary beds. In taking a comprehensive view of this structural phenomenon in the two hemispheres, the bearing of the vertical cleavage planes was described to approximate very closely to the direction of the true meridian, from the southern zone to the arctic regions. This important fact the author asserted, from observations made by himself and others, from Terra del Fuego to California, and from Australia to the Ural Mountains. After reference was made to the geological sections of the different regions, the author expressed his conviction that the propagation of erroneous views, such as those of the sedimentary origin of the primary slates and their being subsequently lifted to high angles, tended to vitiate the foundation of geological science as now taught.

The rocks which produced gold, and from which so large a quantity of that metal had lately been obtained, merely by digging and washing, belonged, it was stated, entirely to the primary series, and not to the fossiliferous or sedimentary beds, as had been sometimes assumed. It appeared, that the less the vertical edges of the primary slates were covered by compact sedimentary rocks, the more favourable were the conditions of the superficial actions for decomposing and liberating their metallic contents. Gold was never detected in the sedimentary rocks excepting in combination with quartz or pyrites, and then only in the vicinity of the primary series, and consequently derived therefrom. It was asserted and shown in a section, exhibited by the author, that it was by the superficial disintegration and final decomposition of a certain variety of the meridional crystalline bands that the gold deposits of South America, Veraguas, California, Australia, Africa, India, and the Ural were produced; and the same description of structure and composition served for all the auriferous regions.

The more uniform the vertical and polar structure appeared to be, the more prolific the primary series was found in gold, and *vice versâ*, in all the regions yet explored. It was possible, on a cursory examination of the structure and composition of the primary rocks, to determine what metals or minerals they would produce, and also whether such products would be found disseminated throughout the bands of rocks, or be aggregated into masses.

The author described an interesting natural process, sometimes detected in the auriferous granite, where these rocks decomposed towards the surface into an aggregation of round balls. It was stated, that during this change, an efflorescence of black ferruginous mineral with gold became formed in the divisions of the concentric foliating

coatings of the balls, which by disintegration liberated the precious metal.

Again, by the aid of surface moisture, and the absorbing action of the roots of large trees, growing on the edges of gold-bearing rocks, these rocks become gradually disintegrated and decomposed, the protoxide of iron being converted into the friable peroxide and the alkali of the felspar was taken up by the roots, leaving the metal behind, precipitated and aggregated into masses. Some of the gold nuggets of Australia and Chili had been found under such circumstances. These metallic productions were confined to no fixed period; on the contrary, the process appeared to be incessant, and only varying in its amount and intensity according to local circumstances.

In order to predict, with any degree of accuracy, the existence of gold in any given region, in quantities worthy of commercial consideration, the author stated, that it was indispensable to ascertain the following particulars:—

1st. If the primary series was uncovered by sedimentary rocks and subject to disintegration, &c.

2nd. If the structure was found in a vertical, and, more or less, in a polar direction.

3rd. If the meridional crystalline bands predominated in ferruginous argillaceous schists, with talcoze and quartzoze slate, as described in the sections.

It was commonly imagined that the diggers were obtaining great riches, and, therefore, that public companies ought to make great profits. Now, according to the author, this idea was founded in misconception. The diggers, on an average, barely obtained an amount of gold equal in value to 2*l.* per man per week; whereas the companies paid upwards of 3*l.* per week for similar labour; this fact, coupled with that of the companies not being able to procure productive gold ground, would, to some extent, account for their ill success in the colonies.

The following statement was given, to show the value of gold obtained since 1851, chiefly by ordinary digging and washing, from two of the most productive gold regions in the world—California and the colony of Victoria—

CALIFORNIA.

In 1851. Value in round numbers	£6,898,500
1852 " "	9,155,800
1853 " "	10,781,400
1854 " "	10,302,000
1855. Estimated (on 9 months' produce) . . .	8,644,000

THE COLONY OF VICTORIA.

Part of 1851 and 1852. Value in round numbers .	£14,000,000
1853 " " .	11,500,000
1854 " " .	8,300,000
1855. Estimated (on the produce of 9 months)	8,000,000

The author expected, that by granting more liberal terms to systematic companies of diggers, increasing the facilities for obtaining

and accumulating water, adopting improved modes of washing, &c., the produce of gold from the colony of Victoria alone would not fall much below the value of 6,000,000*l.* per annum, for some years to come, which was about double the amount of gold now obtained from the Ural, or Siberian gold-fields.

The next evening Meeting of the Institution was devoted to the discussion of Mr. Hopkins's paper, when the author's novel theory was much opposed; but much corroborative evidence was also adduced of the correctness of the observations in the paper.

DISCOVERY OF GRAPHITE IN THE MALVERN HILLS.

A WORK of some magnitude is now proceeding in the vicinity of Malvern, no less than that of tunnelling through the base of the Malvern Hills. The junction, on the east side, of the syenite and the red sandstone has been already disclosed, and a mineral has been discovered, either identical with or closely allied to Graphite. The following remarks by a Correspondent were made during an examination of the tunnel:—

"Arrived at the bottom of the shaft, we commenced our observations, and, working eastward, we came to the edge of the syenite, and found a band of grey marl, in a moist and clay-like state, in contact with it, dipping at a high angle. This we very carefully measured, and ascertained by the clinometers the angle to be 54°. Walking on in the same direction, we passed through red marls, mingled occasionally with grey, all dipping eastward, until, at a distance of 45 feet from the syenite, we discovered the first band of Keuper shale. The dip of this we took carefully, and found it 37°. The marls in the neighbourhood of these shales were so highly indurated as to have the appearance of very compact sandstone. Proceeding eastward, we noticed several thin bands of Keuper shale, the dip varying very considerably, some of them being almost horizontal, while the perpendicular, the dip of the highest was 57°. I conclude from this circumstance that they must have been subjected to local disturbance subsequent to the general upheaval. We noticed nothing farther that seemed remarkable on the eastern side, and, having reached the end of the working, we retraced our steps to the shaft, and began our inspection of the interior of the Malvern Hills. I should state that the syenite in immediate contact with the new-red seemed very loose and broken up, and at first I was disposed to think this was the result of the grinding process in upheaval; but finding no fragments among the clay and marl, I came to the conclusion that its fragmentary and rotten appearance was produced by the action of water, a considerable quantity of which was held against it by a barrier of clay.

"We journeyed westward, and carefully examined the syenite as we went. Its appearance is varied as at the surface, but we saw no variety of rock differing from the surface or quarried specimens we are familiar with, excepting that the hornblendic syenite is of a much lighter colour, approaching in appearance the chlorite of the Wytch. Associated with this particular variety of rock, at 111 yards west of the shaft, we found the black shining mineral which Professor Phillips pronounces

graphite. It there appears in a vein about 6 inches wide; a large quantity has been worked out, and now, at 123 yards from the shaft, the vein has a width of nearly 3 feet; it is much mixed up with masses of quartzoze and felspathic rock, and is so loose and schist-like that quantities of it may be knocked down with a stick or hammer. The direction it takes is from south-west to north-east, and as it appears to be increasing in mass, we may hope to pass through a considerable quantity, and it may probably improve as we approach the centre. Several springs make their appearance in the tunnel, but they all rise from the bottom."—*Edinburgh New Philosophical Journal*, No. 3.

AMERICAN COAL-FIELDS.

THE three great Coal-fields in America are,—the Ohio, 740 miles long and 180 wide, covering an area of 60,000 square miles, a greater surface than that of England and Wales. The Illinois coal-field covers 500,000 square miles; and the Michigan occupies 15,000 square miles. Besides these, there are numerous anthracite basins in Pennsylvania and Virginia, the furthest being 100 miles from the margin of the Ohio coal-fields. The coal, the bituminous coal-field of the Ohio, is 2800 feet deep. The working of these coal-fields is increasing very rapidly; 3,000,000 tons of anthracite and 1,000,000 tons of bituminous coal are raised annually.

COAL IN ASIA MINOR.

A PAPER has been read to the Geological Society "On the Coal of the North-Western Districts of Asia Minor." Mr. H. Poole, in his Reports to the Government on the result of his journey to Asia Minor, to examine into the probability of workable coal being found in the country near Brussa and Ghio (Bithynia), in which coal has been reported to occur, states that he travelled from Ghio to the Lake Ascania, and around its shore, without finding any trace of coal; then from Yallova inland to Ortokoi, with like result. He next went from Yallova westwards along the coast as far as Kornikoi, where a bed of lignite, nine inches thick, was worked to some extent by the Armenians four years since; thence he went inland to Sulmanli without seeing any indications of coal. In consequence of the rumours of the existence of coal near the Lake of Apollonia, Mr. Poole travelled round that lake, but met with none. Mr. Poole next went from Yallova south-eastwardly to Tchougnoorkoi, where lignite, varying from one to four feet in thickness, and dipping at a high angle, has been also worked by the Armenians. This lignite is of no promise. Another excursion was to the Lake Sabandja, where a thin seam of lignite crossing the road on the south of the lake, and a lignite at Ag Sophé, to the east of the lake, were visited. Nowhere did Mr. Poole find proof of the existence of good workable coal in the districts visited.

NORTH OF ENGLAND COAL-MINES.

In a lecture "On the Mining Districts of the North of England," recently delivered by Mr. T. Sopwith, F.R.S., at the Royal Institution, it was stated that the production of the Coal Mines of the Northum-

berland and Durham district now reaches an amount little, if any, short of 14,000,000 tons annually. In round numbers, and as conveying a general approximation, it may be considered, that of this quantity 6,000,000 are destined for London and the coast trade, and about 2,000,000½ exported abroad. The consumption of coal for coke (inland, coast, and foreign) is about 2,000,000½. Colliery engines and workmen consume upwards of 1,000,000 tons; and the ordinary local consumption of the district may be taken at about 2,000,000. Of this enormous quantity, a conception can only be formed by reducing it to some other standards of comparison, as for example:—This quantity of coal, if formed into blocks of one cubic yard each, would cover about four square miles; and if the same quantity of coal be considered as forming the coating of a road, one inch thick and six yards wide, it would extend considerably more than four thousand miles. Blocks of one cubic foot can be readily comprehended; and if one person were employed to count these blocks at the rate of 3600 in every hour, and 36,000 every day, it would occupy him more than ten years to complete his task.—*Mechanics' Magazine*, No. 1654.

THE COAL PLANT STIGMARIA.

Dr. Fleming had read to the Royal Society of Edinburgh a paper on this subject; in which, after noticing the proofs of Stigmaria being the root of Sigilaria, he called attention to the external organs, known formerly as the leaves, and more recently as the rootlets of the former. He stated that in the many examples of stigmaria which he had examined, he had never observed these rootlets articulated to the stem by anything resembling a ball-and-socket joint, considering the appearance which had led to this notion as due to shrinkage and state of preservation.

The views of Dr. Hooker, as given in his valuable paper on Stigmaria in the *Memoirs of the Geological Survey*, vol. ii. p. 437, were next considered. This acute observer, from an examination of a particular specimen, concluded that these rootlets, *within* the body of the stem, form obconical or flagon-shaped bases, the summits of which are on a level with the mouths of the cavities in which they are contained.

In the two specimens which Dr. Fleming exhibited from the Boghead parrot coal, it clearly appeared that the rootlets communicated directly with the body or trunk, which in this case had been filled from within, with the pulpy matter of the coal, and had thus entered the tubular rootlets which extended for some distance into the argillaceous matter on the outside. Hence he inferred that the flagon-shaped bodies noticed by Dr. Hooker were the lower portions of the rootlets, not in the inside, but on the *outside* of the stigmaria.

Dr. Fleming next exhibited examples of the different *quantities* of coal produced by stigmaria, sigillaria, favularia, calamite, sternbergia, and lepidodendron, observing, that as these plants can furnish coal-making materials *separately*, and as their remains exist in coal, it cannot be denied that, in the *aggregate*, they would be equally productive, nor, with these facts in view, could it be maintained that coal can only be formed from fir or allied woods.

The author then proceeded to observe, that in ordinary household coals, such as caking, cherry, or splint, each bed is stratified, and the strata are separated at their *partings* by patches of fibrous anthracite, as if formed from broken portions of woody matter. These partings indicate a recurring intermittency of action, probably arising from *season changes* during the accumulation of vegetable matter in a form analogous to peat. The parrot coals, on the other hand, by the absence of stratification (being merely laminated or slaty parallel with the plane of stratification of the neighbouring sedimentary rocks), indicate a more decidedly simultaneous origin, and appear to have been in the state of disintegrated vegetable matter, mixed more or less with earthy mud, and distributed like the beds of sandstone and clays. That these coals were originally clays, into which bituminous matter was injected, will not be countenanced by any one acquainted with their structural character, contents, and relative position. There is no bitumen in the Boghead parrot, nor any substance analogous to what has been termed ozokerite from Binny Quarry, to which Dr. Bennett has referred. The last substance, indeed, melts at a heat considerably below that of boiling water.

The pulpy condition of the original material of the parrot coals must have been favourable for the molecular changes usually termed metamorphic, which may have so far modified the forms and structures of the vegetable tissues as to give them a segregrated or concretionary character.

The author concluded by remarking that the Boghead parrot could not be considered as a new *mineral species*, for it is neither chemically, optically, nor mechanically homogeneous, as demonstrated in the papers of Professors Bennett and Balfour in the last part of the Society's *Transactions*.

ARCTIC FOSSILS.

CAPTAIN SIR E. BELCHER has read to the British Association a paper "On the Discovery of the Ichthyosaurus and other Fossils in the Arctic Expeditions." These remains were found on the summit of Exmouth Island, about 700 feet above the sea, the upper strata of which is a bed of limestone about thirty feet thick, containing the fossils. The specimens have been submitted to Professor Owen, who considers them to resemble the *Ichthyosaurus actetus* of the Whitby lias.

ROCKS AND FOSSILS FROM THE ARCTIC ARCHIPELAGO.

SIR RODERICK MURCHISON has read to the Geological Society a communication "On the Rock Specimens, Organic Remains, and Fossil Wood, collected in the Arctic Archipelago by Captain M'Clure and Lieutenant Pim." The author gave a brief account of the rock specimens submitted to his notice some time since by Captain M'Clure and Lieutenant Pim, and stated that he had subsequently been favoured with an inspection of other specimens collected by Sir E. Belcher; from all of which he inferred that the oldest sedimentary rock of the Arctic archipelago is the Upper Silurian limestone, which contains several

corals and other fossils known in the formations of that age in Gothland, Wenlock, and Dudley. No clear evidence has been afforded as to the existence of Devonian rocks, though extensive masses of red and brown sandstone may belong to that formation. True carboniferous *Producti* and *Spiriferi* have been brought home by Sir E. Belcher from Albert Land, north of Wellington Straits; and coaly matter has been detected in many localities. Secondary rocks, it is surmised, may exist in the smaller islands north of Wellington Channel, as fossil bones of saurians were found in them. As there are no clear traces of the old tertiary rocks, the author inferred that the older deposits of the Arctic region had been elevated at an early period, and had remained in that position during a very long time; for the objects to which the attention of the geologist is next drawn by the collections of the voyagers, are certain silicified stems of plants, which are widely spread over all the islands between Wellington Channel and the east and west coast of Banks's Land, and which, from the examination already bestowed on them by Dr. Hooker, appear to be allied to, if not identical with coniferous trees. At one spot, namely, Coxcomb Range, Banks's Land, and at a height of 500 feet above the sea, Captain M'Clure collected a large *Cyprina*, undistinguishable from *C. islandica* of the glacial drift of the British isles. There are small stems of plants, some of which exhibit passages from a silicified condition to that of lignite and of wood, and numerous fragments of which seem to be referable to existing species of coniferæ. Most of the specimens were buried in frozen mud or silt, and these have preserved, during a long period, their woody fibre in a natural condition.

Attention was particularly directed to the portion of a trunk of one of these fir-trees, three feet six inches in circumference, which had been procured by Captain M'Clure from a ravine in Banks's Land, where much of the wood is strewed about, in different states of preservation, at heights varying from 300 to 500 feet above the sea, together with cones apparently belonging to an *Abies*, resembling *A. alba* (a plant still living within the Arctic circle). One of Lieutenant Pim's specimens of wood from Prince Patrick's Island is of the same character, and much resembles *Pinus strobus*, or the American pine, according to Professor Quekett, who refers another specimen, brought from Hecla and Griper Bay, to the larch.

Having alluded to the fact of the remains (including entire skeletons) of whales having been found by Sir E. Belcher to the north of Wellington Channel, at considerable heights above the sea, the author inferred that the existence of the remains of these animals with those of fir-trees of considerable size, in latitudes ranging from 74° to 78° 10′, could be most easily explained by supposing that the greater portion of this region was submerged, when the remains of whales and the *Cyprina* were lodged on a former submarine surface, and when quantities of wood were floated or carried by ice-floes (accompanied by much silt and detritus) from the mouths of the nearest great rivers; a subsequent elevation of such sea-bottom having produced the present relations. At the same time he admitted that a case which had been brought to his notice by Sir E. Belcher, might induce some persons to believe that the

trees grew upon the spot where their remains are now found; since that officer examined a trunk in lat. 75° 30′ north, and long. 92° 15′ west, which he states to have been in a vertical position, with its roots extending downwards into a clayey and peaty soil with sand. Remarkable as this case is, and leading, as it might, to the inference that a very different climate prevailed here when such vegetation existed, the author prefers the simpler view above mentioned to one which would necessarily involve the hypotheses of,—1. A much warmer climate, at a time when these Arctic lands were high above the sea; 2. A depression to the extent of several hundred feet, to account for the distribution of Arctic marine animals over the surface; and, 3rdly, another elevation to bring about the present configuration. In short, however willing to allow for great upheavals and depressions in quasi-modern times, the author does not see how the co-existence of the remains of whales and marine shells with living species of trees on the *same lands* can be satisfactorily accounted for, except by a former action of drift, similar to that which covered Northern Europe and North America with erratics and *débris*,—the polar examples differing only from those of other countries by the preservation of wood in its pristine condition through the excessive cold of the Arctic region. Since the above was communicated, a large series of specimens have been received from Captain Kellett and Captain Collinson, which corroborate the foregoing conclusions.

COAL FOSSILS OF NOVA SCOTIA.

Mr. W. J. Dawson has read to the British Association a paper "On the Fossils of the Coal Formation of Nova Scotia," in which he described the strata of the coal-measures of that country as extending to a depth of no less than 14,000 feet, containing 60 distinct surfaces, covered with plants and trees. He spoke of the marine and land deposits collected in the delta, where the roots of the calamite hold together the mud which, forming into flats, sink down to receive others. Mr. Dawson's paper was illustrated by a rich collection of specimens of the fossils.

In a conversation which followed, it was shown that many of the fossil remains described by Mr. Dawson as existing in the coal-formations of Nova Scotia are to be found also in the coal-fields of Scotland.

FOSSIL SIRENOID MAMMAL FROM JAMAICA.

Professor Owen has read to the Geological Society a paper on this fossil, which is completely petrified and adherent to the mass of rock in which it is embedded, and by the fracture of which into three pieces it was brought to light. Sufficient of the matrix has been cleared away to demonstrate the mammalian character of the occiput; the round orbit turned upwards by the outward development of its lower border; the large, almost horizontal, nostril, extending to between the orbits; a thick, convex, deflected muzzle, formed by the pre-maxillary bones; and a lower jaw which resembles in some of its characters that of the manatee. The texture of the bone shows the same dense compact character as in the sirenoid mammals. The forepart of the lower jaw

contains incisors and a canine; the molars are numerous, with two or more roots, adapted, like those of the manatee, for bruising vegetable substances, but with a different form. The author terms this fossil mammal the *Prorastomus sirenoides*. It is from a compact limestone, underlying and different from the ordinary carious tertiary limestone of Jamaica, and resting on conglomerate and sandstone in the central high ground of the island, and submitted to the author's examination by Mr. H. H. Shirley, of Freeman's Hall estate, Jamaica, near which place the fossil was found.—*Literary Gazette*, No. 2002.

REMAINS OF THE DICYNODON TIGRICEPS FROM SOUTH AFRICA.

PROFESSOR OWEN has read to the Geological Society, a paper, wherein he described a new species of extinct bidental reptile (*Dicynodon tigriceps*), transmitted by Mr. A. G. Bain, from South Africa. The skull surpasses in size that of the largest Walrus, and resembles that of the lion or tiger in the great development of the occipital and parietal ridges, the strength of the zygomatic arches, and the expanse of the temporal fossæ,—all indicating the possession of temporal (biting) muscles as largely developed as in the most powerful and ferocious of the carnivorous mammalia. This unique modification of a sauroid skull is associated with the presence of a pair of long, curved, sharp-pointed, canine tusks, descending as in the machairodus and walrus, outside the lower jaw when the mouth is shut, these tusks being developed to the same degree as in the smaller species of Dicynodon (*D. lacerticeps*, *D. testudiceps*, &c.,) described by the author in a former memoir; and, as in those species, so in the present more gigantic one, no other trace of teeth was discernible, the lower jaw being edentulous, as in the extinct Rhynchosaurus, and the Chelonian reptiles. Most of the extinct reptiles exemplify the law of the prevalence of a more general structure, as compared with the more specialized structures of existing species. The Labyrinthodonts combined Sauroid with Batrachian characters; Rhynchosaurus, Sauroid with Chelonian characters. The Ichthyosaurus had modifications borrowed from the class of fishes, and the Pterodactyle others borrowed from the type of birds and bats,—in both cases engrafted on an essentially sauroid basis. The Dicynodonts—which were like lizards in their more important cranial character, as, for example, the divided nostrils, the dependent tympanic bone, and the pair of symmetrical suboccipital drocesses—resembled the crocodiles in the extent of ossification of the occiput, resembled the Trionyces in the extent of ossification of the palate, and in the form and position of the posterior nostril; and resembled the Chelonia generally in the edentulous trenchant border of the whole of the alveolar part of the lower jaw, and of a great part of that of the upper jaw. But they also superadded to this composite reptilian structure of the skull a pair of long, sharp, descending tusks, and temporal fossæ and ridges, which seem to have been borrowed from the mammalian class.

ON THE GEOLOGIC RANGE OF THE PTERYGOTUS PROBLEMATICUS.

BY THE REV. W. S. SYMONDS, F.G.S.

"ONE of the strangest organisms of the formation," says Mr. Hugh Miller, in *The Old Red Sandstone*, "is a fossil lobster of such huge proportions, that one of the average-sized lobsters, common in our markets, might stretch its entire length across the continuous tail-flap in which the creature terminated."

This crustacea is the "seraphim" of the Forfarshire quarrymen, and was for a long time supposed by Agassiz to be a "fish." Mr. Hugh Miller gives an interesting account of the rèstoration of the "lobster" by the great ichthyologist himself.

Nearly allied to the Scotch fossil and the recent Limulus of the West Indies is the Pterygotus problematicus of the Silurian rocks of England, and the object of this paper is to draw the attention of geologists to the remarkable range of that crustacean, and the association of a highly-organized entomostracan with groups of fossils so widely separated as are the trilobites and molluscs of the Caradoc conglomerate from the ichthyolites of the Old Red Sandstone.

In the collection of the Malvern Natural History Field Club is a portion of one of the "thoracic feet," discovered by Mr. John Barrow, in the Caradoc conglomerate of Eastnor Park. This fossil is alluded to by Sir R. Murchison (*Siluria*, p. 237), to whom the circumstance of its detection was communicated by the late Mr. Hugh E. Strickland. It is associated with lingula crumena, lingula attenuata, arca Eastnori, and pterinea orbicularis.

Another "thoracic foot" was found by the writer at the base of the Upper Ludlow shales at Gorstley Common, Newent, Gloucestershire, and was examined and named by Mr. J. W. Salter. Rhynconella Wilsoni occurs in the same rock!

The fine specimen of the limbs of this palæozoic crustacean in the cabinet of the late Mr. H. Strickland, has been fully described (*Quarterly Journal of the Geological Society*, Nov. 1852, vol. viii.) by Mr. J. W. Salter. The *locale* of this fossil was in close proximity to the Upper Ludlow "bone bed" of Hagley Park, near Hereford; and it was discovered associated with avicula retroflexa, orthis lunata, and orbicula rugata by the late Mr. Mackay Scobie.

A few weeks ago I examined a fine collection of the remains of pterygotus in the cabinet of Mr. R. Banks, of Kingston, from the "tilestones" of Bradnor Hill. One of the claws of this animal is superior to the fossil of Hagley Park, while thoracic feet, spines, and the plates figured (*Silurian System*, Pl. IV. 4 *a*), occur in great abundance. The only fossil hitherto detected in the "tilestones," with the remains of pterygotus, is lingula cornea. The "Arbroath paving-stones" of the old red sandstone contain numerous fossils of the same crustacean (*Siluria*, p. 247). Thus, we have a range for the pterygotus from the Caradoc conglomerate to the Devonian rock of Arbroath inclusive—a range even greater than that of the long-lived Calymene Blumenbachii. —*Edinburgh New Philosophical Journal*, No. 2.

FOSSILS IN THE LIMESTONES OF DURNESS, SUTHERLAND.

MR. C. W. PEACH, in a paper read to the Royal Physical Society, after stating that the limestone beds of West Sutherlandshire had been referred by Mr. Hugh Miller to the old red sandstone formation, although the absence of fossils had prevented his asserting this positively, stated that he had been fortunate enough to detect in the limestone of Durness distinct traces of spiral shells, probably goniatites or clymeniæ, which exist, though not abundantly, between Balnakiel and the Kyle of Durness. Besides the whorled shells, coral-like markings were very abundant, as well as the pipe-like forms found by Mr. Miller in the quartz rocks of Assynt. He found amongst the blocks scattered over the face of the country around Durness, and on the tops of the dykes, several containing these strange forms, and he immediately detected their similarity to those he had found at Goran Haven, Cornwall, in the quartz rocks. The Cornish ones he described in a paper published by the Royal Geological Society of Cornwall, as like the sandy tubes made by the *Sabellaria alveolata*, so abundant on that coast, and occasionally found on all the coasts he was acquainted with. He still saw the resemblance in the Sutherland ones, and it would be a very interesting fact if, besides these "pipes," trilobites, orthidæ, &c., should be found in the Assynt quartz, as well as the Cornish.

Mr. H. Miller stated at the close of Mr. Peach's paper, that he had twice visited the north and west of Sutherland, in order to acquaint himself with the character and relations of the formation in which Mr. Peach had been so successful. But though he had examined with some little care the cherty concretions of the limestone of Durness, he had found no such decided organisms as, one at least, of the specimens on the table. The apparent whorls in the rock had attracted his notice; but the region was one in which mistakes had already been made; M'Culloch had regarded the white cylinders of Stonechrubie as organic; and the late Mr. Hay Cunningham had fallen into what was deemed a similar mistake respecting the supposed tubes of Loch Erribol; and as he could get no such unequivocal organisms as the one on the table, he did not venture to come to any conclusion regarding them. One well-preserved fossil, however, helps to throw light on many obscure ones, and such was the cast specially referred to by Mr. Peach, now before the Society. It was evidently that of a whorled shell, though, as its whorls were not on the same plane, neither a *Clymenia* nor a *Goniatite*. It was not improbable, however, that the other whorled shells on the table belonged to the former genus—a genus of which no fewer than forty-three species had been found in the old red sandstone of other countries. Mr. Miller then went on to show the stratigraphical relations of the Durness limestone. It was overlaid, he stated, by a vast deposit of quartz rock, corresponding apparently to the sandstone of Tarbat Ness and Dunnet Head, and underlaid by a coarse-grained red sandstone, the analogue, it would seem, of the great conglomerate; while the limestone itself appeared to belong to the same geologic horizon as the flagstones of Caithness and Orkney, and the fish-beds of Cromarty and Ross. No very decisive finding, however, could be based on the organisms yet found.

Sir R. I. Murchison has read to the British Association, a paper "On the Relations of the Crystalline Rocks of the North Highlands and the Old Red Sandstone of that Region, and on the recent Fossil Discoveries of Mr. C. W. Peach." This paper contained an elaborate discussion of the position of the limestones of Durness and Erribol in the geological series. The author stated that the fossils discovered by Mr. Peach, in the former of these limestones, have been submitted to Mr. Salter, who considers them to approach very closely to the genus Raphistoma, found in the Lower Silurian limestones of Girvan. He stated that in the North of Scotland there appeared to be a regular succession of rocks from the older to newer, in passing from west to east.

THE LESS KNOWN FOSSIL FLORAS OF SCOTLAND.

Mr. Hugh Miller has read to the British Association the following important paper on this subject.

Scotland has its four Fossil Floras: its Flora of the Old Red Sandstone, its carboniferous Flora, its oolitic Flora, and that Flora of apparently tertiary age, of which His Grace the Duke of Argyll found so interesting a fragment, overflown by the thick basalt beds and trap tuffs of Mull. Of these, the only one adequately known to the geologist is the gorgeous Flora of the coal-measures, probably the richest, in at least individual plants, which the world has yet seen. The others are all but wholly unknown. Two of their number—the Floras of the Old Red Sandstone and the oolite—were then illustrated by Mr. Miller. The two great Floras—remote predecessors of the existing one—that once covered with their continuous mantle of green the dry land of what is now Scotland, are represented by but a few coniferous fossils, a few cycadaceous fronds, a few ferns and club mosses. We stand, says Mr. Miller, on the further edge of the great Floras of by-past creations, and have gathered but a few handfuls of faded leaves, a few broken branches, a few decayed cones. The Silurian deposits of our country have not yet furnished us with any unequivocal traces of a terrestrial vegetation. Professor Nicol, of Aberdeen, on subjecting to the microscope the ashes of a Silurian anthracite which occurs in Peebles-shire, detected in it minute tubular fibres, which seem, he says, to indicate a higher class of vegetation than the algæ; but these may have belonged to a marine vegetation notwithstanding. Associated with the earliest ichthyic remains of the Old Red Sandstone, we find vegetable organisms in such abundance, that they communicate often a fissile character to the stone in which they occur. But, existing as mere carbonaceous markings, their state of keeping is usually so bad, that they tell us little else than that the antiquely-formed fishes of this remote period had swam over sea-bottoms darkened by forests of algæ. The immensely developed flagstones of Caithness seem to owe their dark colour to organic matter, mainly of vegetable origin. So strongly bituminous, indeed, are some of the beds of dingier tint, that they flame in the fire like slates steeped in oil. The remains of terrestrial vegetation in this deposit are greatly scantier than those of its marine Flora; but they must be regarded as possessing a peculiar interest, as

the oldest of their class in, at least, the British Islands, whose true place in the scale can be satisfactorily established. In the flagstones of Orkney there occurs, though very rarely, a minute vegetable organism, which I have elsewhere described as having much the appearance of one of our smaller ferns, such as the maidenhair spleenwort or dwarf moonwort.

But the vegetable organism of the formation, indicative of the highest rank of any yet found in it, is a true wood of the cone-bearing order. I laid open the nodule which contains this specimen, in one of the ichthyolite beds of Cromarty, rather more than eighteen years ago; but though I described it, in the first edition of a little work on *The Old Red Sandstone*, in 1841, as exhibiting the woody fibre, it was not until 1845 that, with the assistance of the optical lapidary, I subjected its structure to the test of the microscope. It turned out, as I had anticipated, to be the portion of a tree; and on my submitting the prepared specimen to one of our highest authorities, the late Mr. William Nicol, he at once decided that the "reticulated texture of the transverse section, though somewhat compressed, clearly indicated a coniferous origin." I may add, that this most ancient of Scottish lignites presented several peculiarities of structure. Like some of the Araucarians of the warmer latitudes, it exhibits no lines of yearly growth; its medullary rays are slender, and comparatively inconspicuous; and the discs which mottle the sides of its sap chambers, when viewed in the longitudinal section, are exceedingly minute, and are ranged, so far as can be judged in their imperfect state of keeping, in the alternate order peculiar to the Araucarians. On what perished land of the early Palæozoic ages did this venerably antique tree cast root and flourish, when the extinct genera Pterichthys and Coccosteus were enjoying life by millions in the surrounding seas—long ere the Flora or Fauna of the coal-measures had begun to be! The Caithness flagstones have furnished one vegetable organism apparently higher in the scale than those just described, in a well-marked specimen of Lepidodendron, which exhibits, like the Araucarian of the Lower Old Red, though less distinctly, the internal structure. It was found about sixteen years ago in a pavement quarry near Clockbriggs—the last station on the Aberdeen and Forfar Railway—as the traveller approaches the latter place from the north. Above this grey flagstone formation lies the Upper Old Red Sandstone, with its peculiar group of ichthyic organisms, none of which seem specifically identical with those of either the Caithness or the Forfarshire beds; for it is an interesting circumstance, suggestive surely of the vast periods which must have elapsed during its deposition, that the great Old Red system has its three distinct platforms of organic existence, each wholly different from the others. Generically and in the group, however, the Upper fishes much more closely resemble the fishes of the Lower, or Caithness and Cromarty platform, than they do those of the Forfarshire and Kincardine one.

In the uppermost beds of the Upper Old Red formation in Scotland, which are usually of a pale or light yellow colour, the vegetable remains again become strongly carbonaceous, but their state of preserva-

tion continues bad—too bad to admit of the determination of either species or genera; and not until we rise a very little beyond the system do we find the remains of a Flora either rich or well preserved. But very remarkable is the change which at this stage at once occurs. We pass at a single stride from great poverty to great wealth. The suddenness of the change seems suited to remind one of that experienced by the voyager when, after traversing for many days some wide expanse of ocean, unvaried save by its banks of floating sea-weed, or where, occasionally and at wide intervals, he picks up some leaf-bearing bough, or marks some fragment of drift-weed go floating past, he enters at length the sheltered lagoon of some coral island, and sees all around the deep green of a tropical vegetation descending in tangled luxuriance to the water's edge—tall, erect ferns, and creeping Lycopodiaceæ; and the pandanus, with its aërial roots and its screw-like clusters of narrow leaves; and high over all, tall palms, with their huge pinnate fronds, and their curiously aggregated groups of massive fruit.

In this noble Flora of the coal-measures much still remains to be done in Scotland. Our Lower Carboniferous rocks are of immense development; the limestones of Burdie House, with their numerous terrestrial plants, occur many hundred feet beneath our mountain limestones; and our list of vegetable species peculiar to these lower deposits is still very incomplete. Even in those higher carboniferous rocks with which the many coal-workings of the country have rendered us comparatively familiar, there seems to be still a good deal of the new and the unknown to repay the labour of future explorers. It was only in 1854 that Mr. Gourlie, of Glasgow, added to our fossil Flora a new Volkmannia from the coal-field of Carluke; and I detected very recently in a neighbouring locality, though in but an indifferent state of keeping, what seems to be a new and very peculiar fern. There is a Stigmaria, too, on the table, very ornate in its sculpture, of which I have now found three specimens in a quarry of the coal-measures near Portobello, that has still to be figured and described. In this richly-ornamented Stigmaria the characteristic areolæ present the ordinary aspect; each, however, forms the centre of a sculptured star, consisting of from eighteen to twenty rays, or rather the centre of a sculptured flower of the composite order, resembling a garden daisy. In conclusion, Mr. Miller spoke of the profusion of fossil wood—so much so that recently, along with two friends, he had collected several cart-loads of fossil trees, showing the course of creation.

FOSSIL SEEDS.

Dr. Hooker has communicated to the Geological Society two papers: 1. "On some small Fossil Seeds from Lewisham." These minute seed-vessels were found by the late Rev. Mr. Delacondamine. They occurred in the "Planorbis-bed," associated with fresh-water shells, a few dicotyledonous leaves, and the leaves of ferns and other monocotyledons. The flora of this portion of the eocene series appears to indicate a climate not dissimilar from that of England at the present day. For these little fossil seed-vessels the author finds it difficult to indicate a relationship among existing plants. The form and structure of the seed much re-

semble that of magnolia; but the sac contains numerous spores of a cryptogamic character, and perhaps it may rank nearest to Ferns. The author suggests *Rhytidosporum* (wrinkle-spore) as a provisional generic name, and refers it to the same species as Brongniart's *Carpolites ovulum*, from the Paris fluviatile tertiaries. 2. "On some small Fossil Seed-vessels from Bovey Tracey." These little fossils occur plentifully in the Bovey lignites with which Dr. Croker has favoured the Kew museum. The lignite itself is formed of coniferous wood; and a cone, not distinguishable in its fossil state from the cone of the Scotch fir (*Pinus sylvestris*), has been found in these deposits. These small seed-vessels, however, have no relation with the coniferæ, and, like the little fossil seed-vessel from Counter Hill, alluded to in the last paper, are not referable to any known plants. The author, however, regards them as belonging to a group of plants more nearly allied to ferns than to any other known living order. Dr. Hooker recognises these fossils as the *Folliculites minutulus*. The genus to which these fossil seeds are referred is Zenker's, who described an allied species, and the specific name is Sternberg's; specimens have been figured from the brown coal of Germany, and the *Carpolites thalictroides* of Brongniart, from the Paris tertiaries, belongs to the same genus.

NEW FOSSIL BIRD.

THE discovery of a fossil tibia of a gigantic bird, in a clay deposit, at Meudon, near Paris, has been announced to the Academy of Sciences. The bone is of a species of which no remains are known to exist; and it is quite different to those that have been found of the large birds from Madagascar and New Zealand. Judging from the fossil, the bird must have been twenty times bigger than a wild swan, and must have weighed upwards of 400 lbs. The Academy has charged a committee of its members to make a detailed report on the fossil.—*Literary Gazette*, No. 1998.

EARTHQUAKE INDICATOR.

DR. KREIL, director of the Observatory at Vienna, has invented an instrument by means of which he can discover the intensity and direction of shocks of Earthquakes. It is composed of a pendulum oscillating towards any point, and at the lower extremity of which is fixed a vertical cylinder, containing a watch-movement which causes it to turn on its axis once in twenty-four hours. Close to this cylinder is placed an upright piece of wood, to which is fixed an elastic arm, carrying a pencil coming in contact with the cylinder, on which, as long as the pendulum is still, is described an uninterrupted line; but as soon as the earth moves, and the pendulum consequently makes some oscillations, the pencil traces on the cylinder marks, the length and variety of which show the strength and direction of the shocks.

EARTHQUAKES IN 1854-5.

New Zealand.—The writer of a letter from the Valley of the Hutt relates:—On January 23, we were sitting round our table with a friend when, at half-past nine o'clock at night, without the rumbling notice

which earthquakes generally give us, the shock commenced: the house waved to and fro, rocked, and jumped, as you might fancy a ship would when she strikes on a rock; the lights were dashed off the table, books, glass, china, &c., on the shelves round the room, came down, together with the chimney, part of which fell inside and mixed with the ruins of the furniture, &c. Our friend jumped out of the window, and clung to a post outside, but was thrown down then, and obliged to lie on the ground. I rushed to open the door, for fear we should all be jammed in, with no means of taking the family out of the house, but it was some time before I could open it, and then only by watching the waving of the house; and when the door was opened, and I let go my hold of it, I was thrown down, and could not rise on my legs till the shock was over, which lasted about three minutes. No house, but one built with posts let into the ground, and wooden houses put together like a box, as the houses in this country are built, could have outlived such a rattling. Every one in this valley (of the Hutt) lived in tents for some weeks, as the shocks continued for some time. This part for many square miles is rent in every direction; cracks in the ground of many feet in length, and from a few inches to several feet deep, exist over very large spaces, at short intervals from each other; our horse-track to the river, which is about half a mile off, has more than twenty such across it, twelve of which opened and shut with violence during the shock, and threw water to a considerable height over the surrounding bushes. I saw the water, cracks, sand, and mud which were thrown up, the morning after. Five natives were killed in one house in this valley, and one man only in Wellington, fifty-four miles off. There—since the last severe shocks, six years ago—they have built what they imagined to be earthquake-proof wooden houses, and though some of them are much damaged and much property destroyed, only one or two are down. All the brick and mortar ones, however, and all the chimneys, are down, although they do not appear to have felt the shocks so much as we did. Wellington has, however, been raised by the first shock two feet in perpendicular height, and some inches since by the slight subsequent ones. We suppose that we also are raised up, judging by the sea-coast; where the former low-water mark was it is now high-water mark.

South Australia.—A Correspondent residing in the neighbourhood of Truro has communicated the following:—"About eight A.M. a slight vibration of the earth, supposed to be the shock of an earthquake, was experienced in this neighbourhood. At Truro it caused a dull rumbling motion, such as would be produced by a heavily-laden wagon passing somewhat quickly by. At Barton, one mile distant, the sensation was considerable,—buildings shook to their foundations, plates, &c., for the moment, clattering on the shelves, and persons being conscious of a staggering impulse as they stood on the floor of their houses. How far beyond us this tremor extended I am unable to state. The air at the time was tranquil, and though hazy, the sky was almost cloudless; there were no indications of a tempest either near or remote, nor was the heat excessive."—*Adelaide Times.*

Japan.—The following is extracted from the letter of an officer of her Majesty's ship ———, dated Nangasaki, Japan, September 29, 1855:—On the 23rd of December, 1854, the Russian frigate *Diana*, lying in the Bay of Simoda, island of Niphon, experienced the shock of an earthquake, which eventually caused her total destruction. At 8 30 A.M. on the above day, being desirous of shifting their berth, they sent a boat to lay out a small anchor on the bow, and at 9 30 another anchor was laid out on the quarter. At 9 45 she was observed to shake very much for about a minute. At first they imagined her to be aground, but on sounding, eight fathoms water were found round her. The day was beautifully fine and clear, the sky without a cloud, and the water perfectly calm. At 10 A.M. a large wave was noticed rolling into the bay, and the water on the beach very rapidly rising, immersed the village of Simoda; it appeared to them on board the frigate as if the village was sinking. A large Japanese junk was driven on shore with violence, but the frigate held to her anchors. The cutter and captain's gig, which had been undergoing repairs on shore, were seen drifting out to sea, and a boat was sent to pick them up; but about five minutes afterwards, the water (now very muddy) was observed rushing out of the bay. The boats had barely time to fetch the ship when a second wave rolled into the bay. This carried on shore all the boats that were afloat, and on its receding, all the houses that had formed the village of Simoda were washed into the bay, covering the water with ruins of houses and wrecks of junks. The frigate now dragged her anchor, and the second bower anchor was let go, but the ship had not time to bring up when a third wave, larger and more impetuous than the preceding, came rolling in. At 10 15 the water again receded, and only one solitary building pointed out the site of the former village, and that was a Japanese temple, in process of being built. A column of smoke was observed on the side of the hill, but no one could see whence it came, while a strong sulphurous odour filled the atmosphere. After this the water advanced and receded so quickly that regular whirlpools were formed in the bay. At 3 everything was still, and the ship in twenty-two feet water, making twenty-two inches every hour; around nothing could be seen but wrecks of junks and fragments of houses. The whole of the day had been remarkably fine, the wind light, from N.E., the barometer stood during the whole day at 29·87, and the thermometer 58 Fahrenheit. It was late in the evening before the anchors were cleared. The people on shore stated the loss of life among the Japanese amounted to 300. On the 25th they visited the shore, and so complete had been the destruction that it was impossible to find a trace of the town.

In a letter written by the Rev. Joseph Edkins, and communicated to the *Athenæum*, No. 1441, is noticed the coincidence in time of a remarkable rising of water in all the land streams near Hangchew, Hoochew, and Kiahing. It happened on the 24th of December, the day after the earthquake at Simoda, at 5 P.M. The water rose to different heights, varying from half a foot to two or three feet in various parts of the region containing those three cities. The water had gone back to its own level in half an hour. Nothing has been said of any

alterations in the form of the land surface. The land streams in that region are quite shut off from the sea by a system of embankments made long ago to keep out the waters of the ocean. The water at Hangchew and Chapoo is a little salt, through the oozing in of sea-water, but there is never any tide there inland. The tides that come in by the mouth of the Yang-tsze-Kiang do not reach to this part, extending no further than sixty miles up the Shanghae river, the Hwang-poo.

Turkey.—A letter in the *Times* of 1st of March, from Constantinople, states :—Yesterday, at five minutes past three in the afternoon, the shock was felt, and it lasted, as nearly as can be computed, about half a minute. The motion was a sharp, rapid trembling, which caused every pane of glass and every tile on the housetop to rattle ; but the violence of the movement was far beyond that which is generally felt in the earthquakes of the coast of Asia Minor. Between three and five o'clock, no less than six shocks were counted ; two took place between seven and eight o'clock in the evening, and the last was at a few minutes before midnight. The motion was chiefly felt in the upper rooms of houses, where glasses were thrown off the tables, and persons who were standing were obliged to sit down or to cling for support to some fixed object. The British Embassy, one of the most solid edifices in the country, had a stack of its massive chimneys thrown down. Every bell in the palace rang violently, and even in one or two churches. A number of minarets in Stamboul and Pera were thrown down. Business was to a great degree suspended, and husbands and brothers hastened home to see if the female part of their families had received any injury.

From another letter, dated 8th of March :—The accounts from Broussa are terrible. The Earthquake had lasted five days. The great shock of the 28th February destroyed a part of the town, and killed or maimed nearly 300 of the inhabitants. The commencement of the convulsion was preceded by torrents of rain, which lasted more than twenty-four hours, accompanied by high wind and occasional thunder. At three o'clock the sky became suddenly overcast—a strong smell of sulphur was perceived, and the first shock, in less than a minute, overthrew mosques, houses, and bazaars. Nearly eighty mosques were greatly shaken ; not one in the whole city has escaped some damage. The khans were mostly injured, and five of them were completely destroyed, crushing scores of their unfortunate inmates. Of the silk factories, scarcely one has escaped without damage, and a great number of women lost their lives by the fall. Large masses of rock were detached from their beds, and came crashing down the sides of Olympus into the neighbourhood of the town. In one place several houses were crushed by one of these avalanches. The old wall and fort were shaken to the ground, and in their fall buried ten or twelve houses and the factory of Hadji Anastasi, a Greek manufacturer, who also lost his life. As the shocks continued during the night, the whole population at once quitted the town, and encamped in the neighbourhood.

The *Morning Chronicle* Correspondent, dating Broussa, April 11, writes :—"Yesterday evening, shortly before eight o'clock, two or three violent shocks of Earthquake were felt here. In five minutes every public monument and building in Broussa was a heap of ruins.

The city was destroyed—fire having devoured what relics the earthquake had left. Among other noble monuments that have perished is the magnificent mosque of Oulou Djami. Two minarets of this edifice were overthrown in the former earthquake, and the cupola cracked. It is now wrecked from top to bottom, leaving nothing but a pile of crumbled stones, amidst which the celebrated *turbés* of the first Sultan are buried. All the other mosques have experienced a like fate. No stone-built house in Broussa has resisted the terrible shocks. Enormous masses of earth and rock were detached from the flanks of the mountain, above the upper streets of the place, and rolled down upon the Jews' quarter, whose destruction they completed. News has arrived that the village of Tikindji, situated about a league from Broussa, has been totally destroyed. Several hamlets and farm-houses in the vicinity are also reported to have been wrecked by the convulsion." On the same day shocks were felt at Constantinople, but without any serious injury to the buildings. The destruction of Broussa reduced seventy thousand people to a state of deep distress.

Mr. Consul Sandison has communicated to the Geological Society the following note upon the earthquake at Broussa:—After the lapse of six weeks from the first great shock, and its succeeding lesser tremors, a far more severe shock occurred on the 11th of April, at 8 P.M. The shock, which lasted thirty seconds, and was succeeded throughout the night by incessant and alarming shakings, together with an awful conflagration, has totally destroyed the city. Several neighbouring villages also suffered severely. The earthquake appears to have spent its shocks immediately under Broussa and the country within a radius of about two leagues from that centre. This earthquake was accompanied by the outbursts of new springs of hot water at the sites of the hot mineral baths; and the former streams have been greatly increased in volume.

Switzerland.—A writer in the *Scotsman* (C. M.) says that in a letter to M. Prevost of the Institute, M. Edward Collomb states that Earthquake shocks never ceased in the Valais from the 25th of July for several days. The focus of greatest disturbance was above Stalden, on the north side of Monte Rosa. At the commencement, the shocks were felt over a radius of a hundred leagues. They led to the submersion of a great part of the cultivated land, either by causing a subsidence of the soil, as the people supposed, or by opening new springs. It is stated that when the shocks began, the birds, especially the swallows, disappeared.

Italy: Milan.—A severe shock of Earthquake was felt at Milan on July 25, in the direction of east to west. It lasted five seconds, but caused no damage. Most of the clocks in the town stopped, and the thermometer fell from 27 deg. Réaumur to 14 deg. (31 deg. to 63¼ deg. Fahrenheit). The weather was rainy, and on the following morning there was a thick fog.—*Galignani's Messenger.*

France.—In a letter in the *Presse*, from Lyons, the writer relates:—"I was writing, on the 25th of July, in the laboratory of the Palais Saint Pierre. Towards forty minutes past twelve, I clearly perceived a sort of trepidation in the walls. A few seconds afterwards, I felt an

undulation stronger still. I then distinctly felt the third and most powerful oscillation of the earth. I experienced all the sensations of sea-sickness. These various movements lasted about twenty-five seconds, the last only having been generally felt. The direction of the undulations seemed to be from S.W. to N.E.; but others judged it differently. The earthquake was sensible throughout all the neighbourhood. Everywhere people thought the houses were falling down, and sought to take refuge at a distance. At Lyons, at the Natural History Museum, some parts of a plaster cornice were broken off; at Fontaines, several ceilings were cracked." At Grenoble, the shock was a great deal more severe; the houses rocked, and persons in the upper stories thought they were about to be buried beneath the ruins of their dwellings. It was observed that all clocks placed parallel to the movement continued going, whilst those placed contrary to it stopped. Chairs on castors were set rolling, and bells ringing. "A fact," says the *Presse*, "that is worthy of notice is, the immediate effect of the whole upon the public health. At the moment of the shock, which took place (more or less everywhere) a few minutes before one, the great majority of persons were seized with sickness or dizziness. Many thought themselves threatened with apoplexy; some were afflicted with sudden vomitings." These various phenomena were felt not only at Lyons, Grenoble, and in the southern provinces of France, but also at Nancy, Besançon, Dole, Strasbourg, Lons le Saulnier, and over the frontier in the whole extent of the Grand Duchy of Baden. The accounts received from Italy, Switzerland, and part of Germany, agree in stating that the shock extended to all those countries. The time indicated varies from ten to twenty minutes past one, but the variation is probably only caused by difference of clocks. Among other places where the shocks were felt were Erbach, in the Odenwald, Carlsruhe, Friburg, the Baden Oberland, Stutgardt, Ravensburg, Esslingen, Plochingen, &c.

ARTESIAN WELL.

Mr. Joseph Prestwich, Jun., Sec. G. S., has read to the Geological Society a "Notice of the Artesian Well through the Chalk at Kentish Town." The boring of this well has pierced the following succession of beds:—London clay, 236 feet; Woolwich and Reading series, 61½ feet; Thanet Sands, 27 feet; Middle Chalk (usually termed "Upper Chalk" in England), 244½ feet; Lower Chalk, 227½ feet; Chalk Marl, 172 feet; Upper Greensand, 59 feet; Gault, 85 feet; and then 176½ feet of a series of red clays with intercalated sandstones and grits; altogether amounting to 1290 feet. It was expected that, in accordance with the general relations of the lower members of the cretaceous series, as they come to the surface in the districts north and south of London, the sands of the lower greensand formation would be found immediately to succeed the gault in the boring. Instead of the sands in question, the red sandy clays have presented themselves; and the question of the probability of obtaining a supply of water by deeper boring depends upon the fact whether these red clays are a local variation of the gault, and overlie the usual lower

greensand, or whether the lower cretaceous deposits have here put on a new character altogether. The consideration of this important subject was referred to a Committee.

ERUPTION OF VESUVIUS.

The mountain burst forth into violent eruption on May 1, and so continued for three weeks from this day. The *Athenæum* Correspondent wrote from Naples, May 8:—" . . . Near Resina, the boiling lava was flowing down the sides of the mountain, and people were driving and hurrying along the road by thousands. Resina is passed, and we are going up the mountain on foot. We pushed on to the grand point of attraction, and, deviating a little from the road, we crossed the lava of yesterday's deposit. It was an immense black bed of coke, to all appearance; here and there the occasional elevations looked like waves which had been arrested in their course. The heat which ascended was sometimes intolerable; it burned our shoes. We were walking over the blackened crust which lightly lay on the surface of a river of fire. We took up loose pieces of the coke, and the glowing lava appeared, at which we lighted our cigars, and on which, throwing paper and other inflammable materials, flames sprang up. This vast bed, which is now again in motion, was then stationary, yet divided only by an imaginary line from the most remarkable spectacle I ever witnessed—a long fiery extended plain moving on slowly and irresistibly. Although it was nearly a level, yet unceasingly it moved on like an Alpine glacier, carrying everything with it. The noise, too, which marked its course, reminded me at times of the murmuring, rattling kind of noise which an Alpine stream makes as it rolls or rattles over its shingly bed. The masses of coke ground lightly one against the other, and it seemed to one as if a thousand voices were uttering hish—sh—sh.

"There was a point at which this scene, grand as it was, became yet grander. Half way between the Hermitage and the foot of the cone is a vast ravine, which separates Vesuvius and Somma. A different wind might have brought the lava more to the north and west down upon Ercolano; as it was, it took the direction of this ravine, which descends more than a thousand feet below, into the villages of Massa di Somma, San Sebastiano, Madonna del Arco, and others. The first descent into this ravine is precipitous, and over it rolled this stream of fire, in width about 200 feet, forming a cascade of liquid flame. Even in its fall, too, I imagined that it was not forgetful of its dignity:—there was no impetuosity in its movements; it rather moved than dashed over, and then kept on its course through the plantations of poplars and chestnuts with which the sides of the ravines were planted. They are now, of course, utterly destroyed. A sudden flame, and a shriek, and a waving to and fro, and tree after tree succumbed to the power of the fire. The abyss into which the lava rolled might have been unfathomable, for no eye could pierce it, and the huge masses of red smoke which heavily rose from below threw an indescribable air of mystery over the whole, except when a sudden puff of wind arose.

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"Taking for our guide a man who was selling coins, and without any other light than that which proceeded from the mountain, we tumbled along over our rugged path of coke. As we rose higher and higher, we obtained a further view of that marvellous river on our left, which here appeared to be divided into two branches, and a short distance further brought us to the foot of the cone. There were then seven mouths open on this side, vomiting flame, and smoke, and lava, and two of them were throwing up stones, though not large."

Subsequently to that evening, several of the new *bocche* united; another burst forth, when up shot a stream of stones and lava, and a new crater was formed. "The old crater, too (continues the Correspondent), at the summit, is beginning to rouse itself from its lethargy, and is now adding to the destruction which is pouring down upon the devoted country beneath. Another change has taken place in the bed which I first described as that from which I looked down on the fiery cascade. It is also in motion; and to give you any idea of it, I must beg you to imagine Oxford-street or the Strand taking it into its head to go into the country,—not in detached parts, but in one solid, continuous whole. On moves this fiery serpent, now upwards of four miles in length, its jaws devouring plantations and vineyards, whilst its huge body is emerging, coil after coil, from the 'shattered side' of Vesuvius. God preserve the poor people below! I went round the mountain last night to the villages of Massa di Somma and Sebastiano, and met the river in its course. I was there till two o'clock in the morning. I looked on a cascade of glowing lava, without exaggeration one thousand feet in height. It was Niagara on fire; and now it is in the very streets of a village. A portion of Massa di Somma has been destroyed.

A report, drawn up by Professor Palmieri, at Naples, on the late eruption of Mount Vesuvius, states that some days before the commencement of that phenomenon, the most singular irregularity was observed in the dipping-needle, the variations of which became so strong and frequent during the last two days before the eruption as to amount to what the Professor calls a magnetic storm. The magnetic vibrations continued with increased intensity during the eruption; and the electrical state of the atmosphere was equally remarkable, being greater than the maximum in ordinary times; its diurnal period was disturbed, greater electricity having often been observed during the night than during the day; and what was still more singular, during the eruption of ashes the fixed conductors gave but slight indications of negative electricity, while the moveable ones gave the strongest possible signs of positive tension. In general the electrical current appeared to follow the course of the smoke. The barometer remained constantly low, the thermometer on the side where the lava flowed rose eight degrees, and the wind kept veering round to all the points of the compass.

VOLCANIC MOUNTAINS OF HAWAII.

A PAPER has been read to the Royal Geographical Society, "On the Volcanic Mountains of Hawaii, Sandwich Islands," by Mr. James G.

Sawkins; communicated by Sir Roderick Murchison. The island of Hawaii contains four volcanoes—Kohola, Mauna Kea, Haialalai, Mauna Loa—ranging from 9000 to 13,840 feet high. The most remarkable features on the north-east of the island are the immense cliffs of compact lava, separated by ravines varying from 200 to 2000 feet in depth, with numerous cascades falling over their sides. The west and south-west slopes of the island are arid, barren, and desolate; while the north-east and east are moist and covered with luxuriant vegetation, and water-courses derived from exposure to the humid trade-winds. Several craters are in active operation; and the paper described some of the extraordinary volcanic phenomena for which this island is so remarkable.

After reading the paper, a discussion arose, in which the Chairman, Sir George Seymour, and Sir Charles Lyell, took part. Sir Charles, in a very lucid manner, described to the meeting the various remarkable geological features of this curious and interesting island.

ERUPTION OF MAUNA LOA, IN HAWAII.

The *Polynesian*, in a letter, dated Hilo, October 13, gives the following description of the eruption of Mauna Loa, of 13,120 feet elevation:—

"Hawaii still burns. The great furnace of Mauna Loa is in full blast. For sixty-three days the molten flood has rolled down the mountain without abatement. Our Hawaiian atmosphere is loaded with smoke and gases, through which the sun shines with dingy and yellow rays. The amount of lava disgorged from this awful magazine is enormous. The higher regions of the mountains are flooded with vast sheets of smoking lava, while the streams which have flowed down the side of the mountain spread over a surface of several miles in breadth. The main stream, including all its windings, must be more than fifty miles long, with an average breadth of three miles. This is still flowing direct for our bay, and is supposed to be within ten miles of us. It is eating its way slowly through the deep forest and the dense jungle in our rear, and its terminus must be the sea, unless the great summit fountain should cease to disgorge. On the 2nd instant, Mr. M'Culley and myself set off to explore the eruption, taking the bed of the stream, the Wailuku river, as our path. We reached the terminal crater in four and a half days, tracing up the fiery stream from the upper skirt of the forest to the summit of the mountain. In the woods we could not follow it, on account of the dense jungle. The burning stream now runs all the way in a covered duct, so that it can be seen only at its vents, which let off the gas. These are truly fearful. We looked down one of them, and saw the fiery current rushing under us, in some places at the rate of forty knots. We returned *viâ* Kilaueh, and were absent ten days. What we saw and heard and felt cannot be described."

Astronomical and Meteorological Phenomena.

THE STAR 61 CYGNI.

One of the noblest fruits of astronomical research in the year 1854 is the determination of the distance from the earth of the star 61 Cygni, by Mr. Johnson, the Director of the Radcliffe Observatory, Oxford. The parallax of this star, or in other words, its distance from the earth, was originally determined by the great astronomer Bessel, and the result obtained by him was confirmed in a most satisfactory manner by M. Peters, another astronomer of Germany. It appeared from the researches of these astronomers that the distance of the star from the earth is about sixty millions of miles. Consequently light travelling at the rate of 192 thousand miles in a second would require about ten years to traverse the space which separates the star from the earth! The result obtained by Mr. Johnson agrees almost precisely with that assigned by the researches of MM. Bessel and Peters, so that no doubt can now be entertained with respect to the real distance of the star. This is justly regarded as one of the most brilliant triumphs of astronomical science, for the delicacy of the investigation is almost inconceivable, and yet the reasoning is as unimpeachable as the demonstration of a theorem of Euclid.—*Inverness Courier.*

SOLAR SPOTS.

We quote the following from an admirable paper on "The Progress of Astronomy," written for the *Inverness Courier*:—The physical constitution of the Sun forms one of the most mysterious subjects of astronomical science; and, as may be supposed, has always, since the discovery of the telescope, occupied in a greater or less degree the attention of observing as well as speculative astronomers. One of the most interesting features of this body are the spots by which the telescope indicates its surface to be diversified. These spots are in a state of continual fluctuation. Sometimes they appear very numerous on the sun's surface; at other times not a single spot is discernible. It is manifest that they are intimately connected with the physical constitution of the sun, and it has therefore always been an object of great importance to record their appearances and watch their various fluctuations. One of the most assiduous observers of the solar spots is Dr. Wolf, an astronomer of Berne, in Switzerland. By a comparison of all the observations of the spots made, from the epoch of their discovery down to the present time, he has discovered that the number visible on the surface of the sun recurs at regular intervals of time. The mean duration of the interval comprised between two successive maxima or minima, he finds to be somewhat more than eleven years, a period of time which, he remarks, presents a close agreement with that corresponding to the variations of the magnetic needle. He has, moreover, ascertained that the years during which the spots have been most numerous have been always the driest and most fertile, agreeably to a

remark of Sir William Herschel. Sir John Herschel having recently suggested the desirableness of providing means for obtaining daily photographic representations of the sun's surface, with a view to an historical record of the spots, the Council of the Royal Society was induced to take the subject into consideration, and has finally decided upon erecting a photographic observatory for this purpose at Kew. This step cannot fail to be productive of important results relative to the subject of the physical constitution of the sun.

PHYSICAL CONSTITUTION OF THE MOON.

PROFESSOR HANSEN, of Gotha, has recently communicated to the Royal Astronomical Society of London some curious speculations relative to the physical constitution of the Moon. Having remarked some irregularities in the moon's motion, which he found it impossible to account for by the perturbations of the moon or any of the planets, he was led to consider the consequences which would ensue if the centre of the moon's figure did not coincide with its centre of gravity. He found that by supposing such a non-coincidence to exist, there would arise certain irregularities in the moon's motion precisely similar to those which observation indicated. Assuming the irregularities to be wholly due to this cause, he arrived at the conclusion that the centre of gravity of the moon must be situate about thirty-six miles beyond its centre of figure. Hence, the side which is constantly turned towards the earth being elevated considerably above the mean level, and, therefore, in the condition of a high mountain, Professor Hansen remarks that we need not wonder that it appears a barren region, deprived of an atmosphere and of all animal and vegetable life. Since, however, the opposite hemisphere, which is always turned away from the earth, is depressed a little beneath the mean level, Professor Hansen is inclined to suppose that an atmosphere may there exist, and that the regions which it embraces may be the abode of animal and vegetable life. Professor Hansen considers it to be not impossible that volcanic or other similar forces prevailing in the interior of the moon, may have met with far less opposition in the hemisphere which is turned towards the earth than in the opposite hemisphere, and may have thereby caused immense upheavings of the surface. He also seems disposed to think that the long narrow streaks upon the moon's surface, termed "Rills" by the German astronomers, may be rents or splits which have been occasioned by these enormous upheavings of the surface.—*Inverness Courier*.

LUMINOUS METEORS.

PROFESSOR POWELL has read to the British Association his Report on Luminous Meteors, which contained an account of some meteors of considerable interest. One of the most extraordinary was described by Professor Bond, its discoverer being Miss Jenny Lind.

Professor Wolf, of Berne, perseveres in his observations of shooting-stars, begun in 1851; since which time more than five thousand have been noted. He intends to keep on a few years longer, with a view to discover, if possible, the law by which these celestial fugitives are

governed. Already he is enabled to state how many an observer will see in an hour, in each month of the year. In January, five; in July, nine; in August, thirteen; in September, October, and November, four; and in all the other months, about three. From what is now known, the number of shooting-stars that may be seen in any night is much greater than those who never think of watching for them would imagine.

FALL OF METEORIC STONES IN HANOVER.

M. Wöhler states that on the 13th of May last, at five o'clock in the afternoon, a very remarkable fall of Meteoric Stones was observed near Bremeworde, not far from Hamburg. This phenomenon was accompanied by thunder and a great hissing noise. The sky was cloudy, so that the meteor was not seen; but three stones were seen falling, and these were found. It is very probable that a greater number fell. The largest of these stones weighs 3 kilogrammes, the second 1½ kilogramme, and the third 325 grammes.

Like most of the aërolites observed, these stones are covered with a black fused crust. Their fracture shows a mixture of several minerals of a grey colour, amongst which a considerable quantity of metallic iron and sulphuret of iron may be distinguished. They present a close resemblance with those which fell in Transylvania on the 4th of September, 1852, and which form part of the collection in the Imperial Museum of Vienna.—*Comptes Rendus*, June 25, 1855.

METEOROLITES IN THE UNITED STATES AND MEXICO.

Mr. R. P. Greig notes:—"One circumstance may be mentioned as being rather singular, which is, the extraordinary number of Meteoric Irons discovered within a comparatively short period in the United States, viz. thirty-four; while only *one* has been found in France, and but *one* in Great Britain.

In Mexico eight meteoric irons have been discovered and described, but there is no recorded or historic instance of a stone fall; yet in the United States there have been seventeen falls of stone this century, and one observed iron fall.

There is no accounting for these apparent irregularities; possibly several of the Mexican and United States iron meteoric masses have been the result or produce of one shower or explosion.

The proportion of stone to iron falls may be taken at twenty-five to one, *i.e.* 96 per cent. of all that fall consist of stony matter; so that for the thirty-four iron masses found in the United States there may have been 34 + 96 = 3264 stonefalls.—*Philosophical Magazine*, No. 54.

AEROLITE IN SCOTLAND.

A letter from Ochtertyre, Crieff, N. B., dated April 28, 1855, states:—"On the evening of the 23rd, about nine P.M., an Aerolite, or falling star was observed from an upper window by one of my domestics. She immediately informed a lady resident in my family, whose statement of the occurrence was as follows: About nine P.M. on Monday, 23rd of April, I was called to look at what was said to be a star which had fallen, and which was lying on the gravel. Upon going

to a window overlooking the place, I at once saw a bright object lying; it had the appearance of a large diamond upon which the sun was shining brightly. Hastening to the spot, I was instantly sensible of a strong smell of sulphur, but could no longer perceive the bright object. While searching for it, I suddenly felt something warm under my foot; and here were found several small pieces of scorious matter, which were still hot, and emitted a strong sulphurous odour. The scoriæ picked up were about twelve in number, the largest about three-quarters of an inch in length, of an irregular cineritious form and colour, and bearing the appearance of having undergone intense fusion, and they did not appear to have been broken in the fall generally, as they were rounded by fusion. From the inquiries I have made, I believe this to be a true statement of what was observed."

WATERSPOUT AT TUNIS.

Mr. James Squires, in a letter from Tunis, dated November 18, 9 o'clock A.M., describes the following fearful catastrophe as having just occurred in the harbour:—"A Waterspout passed over at half-past 7 o'clock A.M., and in an instant five vessels foundered, and one was dismasted. I was a passenger by a boat which left Tunis at 7 30 A.M., bound to a steamer in harbour belonging to the Messageries Impériales. The lake being eight miles across, we had advanced about half the distance when my attention was attracted to a remarkable cloud, which in a very short space of time assumed the unmistakeable appearance of a waterspout. It continued to grow in size, as well as increase in proportion, until it presented the appearance of a huge oak, a most colossal trunk supporting a majestic head. It moved gradually, causing by its power of suction a corresponding action in the waves over which it passed, they rising in the usual form in such cases.

"In about half an hour it had lost its well-defined outline, and appeared to be gradually dissolving, about which time an immense excitement was visible among the crew and passengers of the boat, all Italians. By dint of perseverance I at length became alive to the awful nature of the event, for rising on the seats of the boat, and looking across the narrow neck of land dividing the lake from the harbour, a scene of the most awful havoc presented itself. Five vessels had disappeared, with the exception of their masts. This was a sight to make a beholder uneasy as to the fate of the various crews and passengers; but as our utmost efforts could have produced (on account of our distance from the scene) no beneficial results, we were reluctantly compelled to allow matters to take their course. On arriving at Goletta we learnt the full extent of the disaster."

WATERSPOUT AT OXFORD.

An observer writes from Oxford:—"On Wednesday evening, July 25th, at six P.M., as we were sitting at dinner, at Headington-hill, a waterspout appeared here. In form it first resembled a partly-broken scimitar; it was twice or thrice withdrawn into the cloud altogether, each time lengthening on its reappearance, till at last it touched the horizon, appearing like a monstrous scimitar, the convex side furthest

from the wind. This appearance continued for several minutes, when a light cloud passed across it, apparently about one-third up; it then separated, and the point from the horizon turned upwards, with the convex side to the wind, and remained as strongly marked as before for several minutes, when the point dispersed, and the hilt was absorbed into the clouds."

Another observer writes:—"At the moment of its breaking it appeared to be moving more rapidly than before, and the broken part seemed to have been dispersed into a mist, so that at first it was doubtful whether the apparent separation was not caused by an intervening cloud. The lower fragment, however, immediately enlarged its dimensions, and after appearing to roll for a few seconds, like a horizontal cylinder, it dispersed.

"The cloud from which the waterspout projected was thick and heavy, with a well-defined and tolerably level under surface."

ON RAIN GAUGES.

Professor Fleming, in a communication to the Royal Physical Society, has remarked that the expensive form in which Rain-gauges were usually made, rendered them comparatively rare; but the gauge recommended by himself in its most expensive form costs only about 1*l.* He pointed out the objections to rain-gauges of the ordinary construction, and particularly to the error which is introduced by having them elevated above the surface, stating that when so placed their indications are not to be relied on. The author gave as the result of experiment, in accordance with theoretical considerations, that rain-gauges need not exceed three inches in diameter; that the trouble attending them may be limited to emptying them once a-month; and that the index-rod, if divided into tenths of an inch, is sufficient for all practical purposes. The eye, with a very little practice, can easily read off to one-fourth of a tenth, a difference often greater than the amount of rain falling at the same time within short distances. He mentioned that gauges of the description which he had recommended were being established in different parts of the country. Twelve parish schools in Annandale were furnished with them by Mr. Bryson, for his Grace the Duke of Buccleuch; and the results, according to Mr. Stewart, Hillside, Lockerby, have been satisfactory. In conclusion, he remarked, that trustworthy observations would not be secured, for generalizations respecting the distribution of rain, until some simple, easily constructed, and inexpensive but accurate form of gauge be adopted, such as he believed his instrument to be; and sunk in a grass plot, as free from the influence of trees, buildings, or local currents of wind as practicable, the grass around the funnel being occasionally trimmed.

COLD WEATHER OF JANUARY, FEBRUARY, AND MARCH,—AND CRYSTALS OF SNOW.

Mr. James Glaisher, F.R.S., has communicated to the Meteorological Society a very interesting paper "On the recent Cold Weather, and on the Crystals of Snow observed during its continuation." The

year 1855 was ushered in with a high temperature, exceeding its average by quantities varying from 8° to 12° daily. On January 10, a cold period set in with a dense fog; and the temperature, which was as high as 49° 6′ on the 9th, fell to 26° on the 10th. This diminution of temperature was accompanied by a change in the wind, which, from blowing a compound from the west, changed to a compound from the east, and, with few exceptions, so continued. On January 12th and 13th the temperature was about its average value; but after the 14th, when the cold set in, its departures were very considerable, particularly over the south-west and eastern parts of England. Scotland and the northern counties were frequently exempt from any share in the great severity of the period, which was also less severely felt at the seaside than at inland places. The lowest temperature, viz. 0°·8, took place at Berkhampstead. At different places in England, on different days, it was as low as 3°, 5°, 7°, and 10°. For a similar period to the one which has just passed, it is necessary to go back to the year 1814. That year, however, commenced with a very low temperature—a frost having set in on December 26th, 1813. The intensity of the two periods was about the same. It ended, in 1814, on March 21st; whereas, with the exception of a short intermission about the first week in March, the temperature of 1855 descended lower and more frequently than it did in 1814, in which year the coldest day was on January 10th, when the reading was 19°·6. The lowest temperature of this year also occurred in January, and was 19°·2. In 1814 the lowest temperature in February was on the 4th, and was 22°. The lowest reading in this month of 1855 was 20°·6, and took place on the 18th; and this February was a much more severe month than the February of 1814. The mean temperature of February, 1814, was 32°·4; and that of 1855 was 29°·3.

The remarkable feature of the above severe weather was the peculiar character and continuous fall of snow; which first made its appearance on January 16th, and laid on the ground from that date till the end of February. The average amount did not at any one time exceed a foot in depth; and its density was of from 8 to 10 inches of fresh fallen to 1 inch of water, which its melting produced. The drifts varied from 5 to 10 feet. The snow this year was of that kind which former writers have designated "Polar snow"—it having been chiefly composed of crystallized particles of compound figure, which they supposed to be confined, with rare exceptions, to the Arctic regions. This supposition, however, is not supported by the great prevalence of innumerable crystals, which exhibited a degree of crystalline formation equal to any that have been recorded as seen in colder latitudes.

The author concludes with a brief summary of each day's observations. On February 8 they commenced with a temperature of 29°, which subsequently increased to 32°, at which the temperature continued for many hours. During the whole of this time, conspicuous for its uniform temperature, the prevailing figure of the crystals continued to change, until towards the close of the day they fell mingled together in the greatest profusion. In the early part of the morning, they were arborescent; these forms suddenly ceased, and were exchanged for hexagons; these again became the centre of a more com-

plicated arrangement; that after a time these diminished in numbers, when the arborescent form again prevailed, and finally a mingling of nearly all that had previously fallen. On February 16, with a temperature of 26°, there were two distinct orders of crystals—those which were arborescent and exhibited an intermediate formation, and those of cruciform character, of solid hexagons cut into numerous facets. February 17, with a temperature of 32° throughout, exhibited figures, it will be remembered, composed of elongated prisms, ranged parallel to each other, and of very similar character. There were, however, exceptional instances of the prevailing character of February 16. On February 21, with the lowest temperature,—viz. 20°, the figures were singularly compound, and departed more than on any previous day from the figure of the regular hexagon. On February 23, the last day of the frost, there were a large number of arborescent crystals of one common character, and which never ceased collapsing into more and more simple figures. On March 8, after a week's respite, the cold set in again. The crystals on this and the next two consecutive days, were of a very distinctive class, of purely stellar figure, and composed chiefly of fine spiculæ.

From these observations it would seem, that however temperature may affect these bodies, it is more than likely that other conditions of a different nature are involved in their first formation. This, apparently, was the view taken by a writer on the subject in the *Philosophical Transactions* for 1672. Speaking of snow crystals (says the Rev. G. Langwith), "It is not easy to determine whether these figures may not be the result of the chemical components of the atmosphere, which as they preponderate, may under certain conditions of temperature give rise to these curiously simple and compounded bodies. Dr. Smallwood, of Isle Jesus, Canada East, imagines to be intimately connected with the electrical states of the atmosphere, whether negative or positive. The foregoing observations show a wide difference between the various orders of crystalline formation, and it would seem from them that the greater the degree of cold the greater the departure from the simple star, with all its variously arranged spiculæ: also that shortly after the descent of a crystal, at any temperature below the freezing point, various processes of change take place, which are evidently an undoing, if not a reversal, of the operations which had assisted in their formation. These changes, through which every crystal never fails to pass, even at temperatures very many degrees below the freezing point, each more destructive than the last of its crystalline and compound figure, led the author to the same conclusions. The subject of snow crystals has engaged the attention of Aristotle, Descartes, Grew, Kepler, Dr. Nettes, Dr. Scoresby, and others; but, like most subjects of meteorological inquiry, it has languished for want of extended and continuous observation. The published information concerning them is, however, likely soon to derive accession from Sir Edward Belcher's observations made in the Arctic Seas. Coming from this experienced and able officer, they will be of substantial benefit to the inquiry into the nature and circumstances of formation of these interesting bodies.

THE ROYAL OBSERVATORY.

The Annual Visitation of the Greenwich Observatory was held on June 2. Lord Wrottesley, as President of the Royal Society, presided at the Board of Visitors. The present Report shows that the Greenwich Observatory maintains its high character for the number and precision of its astronomical observations; for, while it leaves the equatorial and scrutinizing departments of astronomy to other observatories, no expense is spared to render standard meridional observations generally, and meridional and extra-meridional observations of the Moon in particular, as correct as possible.

Thus each of the Stars in the extended standard list is observed, if possible, twenty times in three years. The Moon is observed on the meridian at every opportunity; and, with the exception that the small Planets are not observed at all in the morning watch (from 3 A.M. to daylight), and the large Planets are not observed then, except in company with the moon, the Sun and Planets are observed on the meridian at every opportunity, except on Sundays.

The total number of observations, of all kinds, between May 26, 1854, and May 15, 1855, amounted to 4565.

While the systematic work of the Observatory has been carried on during the past year with undeviating regularity, extraneous works of great astronomical importance have been performed. The most serious and laborious were the pendulum experiments undertaken in the Harton Colliery, for ascertaining the variation of gravity at great depths. The experiments, which were made with the apparatus belonging to the Royal Society, were entirely successful, and proved beyond doubt that gravity is increased at the depth of 1260 by $\frac{1}{19000}$ part.

During the past year, another very important astronomical work has been performed, by which the difference of longitude between Paris and Greenwich has been ascertained. The number of days considered available for longitude, in consequence of transits of stars having been observed at both Observatories, was twelve; and the number of signals was 1703. Very great care was taken on both sides for the adjustment of the instruments. The resulting difference of longitude, 9′ 20″·63, is probably very accurate. It is less by nearly 1″ of time than that determined in 1825 by rocket signals under the superintendence of Sir John Herschel and Colonel Sabine. The time occupied by the passage of the galvanic current appeared to be one-twelfth of a second.

The Astronomer Royal regrets that, while the Greenwich astronomical observations have assumed such a shape that the astronomer will find all the moving bodies of the Solar System presented in the utmost extent and accuracy, the same assertion cannot be applied to the Magnetical and Meteorological Observations:—not, however, from any defect in the instruments or observations; for under the able superintendence of Mr. Glaisher, these have acquired an extraordinary excellence and precision, particularly in the photographic branch of registration. "But," to use the words of the Report, "after having obtained the immediate results of observation with the utmost completeness and exactitude, we are absolutely stopped from making further progress by the total abstinence of even empirical theory."

At the same time, the system and extent of the observations continue unaltered. For the three magnetic elements, and for the barometer and the dry and wet thermometers, eye-observations are made three or four times daily; and these serve as zeros both in time and in measure for the curves formed by continuous self-registration on the photographic sheets. Thus, whenever any extended view of the cosmical causes or laws of magnetism and meteorology shall render an accurate discussion of observations of these phenomena practicable, those made at Greenwich will be found to present such materials for the investigation as can scarcely be obtained at any other observatory.

Such are the principal features connected with our national Observatory contained in the Astronomer Royal's Report; and those who had the gratification of inspecting that establishment in June last, must have been impressed by the admirable condition of the instruments in all the departments. And while the eminent chief of this most important Observatory is highly solicitous that it should be as perfect as possible, he is not unmindful of the claims of those who have preceded him in the laborious field of astronomy to honourable remembrance. It came under his notice during the past year that Halley's tomb, in Lee Churchyard, had apparently received no repair since it was first erected, and was in such a dilapidated condition that a complete restoration could alone preserve it. Under these circumstances, Mr. Airy procured the necessary funds from the Admiralty; and, like a zealous and devout antiquary, was careful that his restoration of this interesting and classical tomb should in all respects resemble the original structure.

OBSERVATORY IN TRAVANCORE.

ASTRONOMER BROUN, in a letter to Colonel Sykes, dated 2nd July, 1855, describes the successful establishment of an Observatory on Augustus Mullay, at 6200 feet above the sea level, for the purpose of simultaneous record with the Observatory at Trevandrum. The difficulties of access to the summit of the mountain were so great, from having to cut paths through dense jungles, infested by elephants and other wild animals,—from having to use ropes and mechanical aid in getting up the building materials, provisions, and the instruments,—and in the delays from the labourers running away from fright and the effects of cold,—that two years were consumed in the undertaking. The object of Astronomer Broun in making known his successful efforts in Europe is to enable observers to put themselves into communication with him, in case they should desire to have any experimental researches made on so novel a position for an observatory.—*Proceedings of the British Association.*

PHOTOGRAPHY APPLIED TO METEOROLOGICAL OBSERVATIONS.

SIR JOHN F. W. HERSCHEL, in a letter to Colonel Sabine, says:—"I consider it an object of very considerable importance to secure at some Observatory, and indeed at more than one, in different localities, daily Photographic Representations of the Sun, with a view to keep up a consecutive and perfectly faithful record of the history of the

spots. So far as regards the general delineation of the whole disc, and the marking out on it, in reference to the parallel to the equinoctial passing through its centre, the places, sizes, the forms of the spots, there would need, I should imagine, no very powerful telescope—quite the contrary; but it should be equatoreally mounted, and ought to have a clock-motion in the parallel. The image to be impressed on the paper (or collodionized glass) should be formed not in the focus of the object-lens, but in that of the eye-lens, drawn out somewhat beyond the proper situation for distinct vision, and always to the same invariable distance, to insure an equally magnified image on each day. By this arrangement a considerably magnified image of the sun, and also of any system of wires in the focus of the object-glass, may be thrown upon the 'focussing-glass' of a camera-box adjusted to the eye-end of a telescope. By employing a system of spider-lines, parallel and perpendicular to the diurnal motion, and so disposed as to divide the field of vision into squares, say of 5′ in the side, the central one crossing the sun's centre (or rather, as liable to no uncertainty, one of them being a tangent to its lower or upper limb), the place of each spot on the surface is, *ipso facto*, mapped down in reference to the parallel and declination circle, and its distance from the border, and its size measurable on a fixed scale. If large spots are to be photographed specially with a view to the delineation of their forms and changes, a pretty large object-glass will be required, and the whole affair will become a matter of much greater nicety; but for reading the daily history of the sun, I should imagine a 3-inch object-glass would be ample. The representations should, if possible, be taken daily, and the time carefully noted as far as possible; they should be taken at the same hour each day; but in this climate, a clear interval, occurring when it may, had better be secured early in the day. Three or four observations in tropical climates, distant several hours in longitude (suppose three at eight hours' distance in longitude), each recording at, or nearly at noon, would, when the results were assembled, keep up a continuous history of the solar disc. With regard to proper preparation of paper, or the use of collodion acid, the photographic art is now so much advanced, that no difficulty can arise in fixing upon fitting preparations, or the manipulations necessary for multiplying them. But it would be very requisite that many impressions of each day's work should be taken and distributed, and an interchange kept up among observers."

METEOROLOGY OF 1855.

Results deduced from the Meteorological Register kept at the Royal Observatory, Greenwich, during the year 1855, *under the Superintendence of the Astronomer Royal.*

Months.	Mean Reading of Barom.	Mean Tension of Vapour.	Mean Pressure of Dry Air.	Temperature of Air. Dry Bulb Therm.	Self-Reg. Therm.	Mean for Month.	Highest.	Lowest.	Range.	Mean Daily Range.	Temperature of Evap.	Evap. below Air.	Dew Point below Air.	Dew Point.	Rain. No. of Days.	Amount in Inches.	Weight of Vapour in Cubic ft. of Air.	Mean additional Weight required to saturate a cubic foot of Air.	Mean Degree of Humidity. Saturation = 100.	Mean Weight of a cubic foot of Air.
	In.	In.	In.	°	°	°	°	°	°	°	°	°	°	°		Ins.	Gr.	Gr.		Gr.
Jan.......	29·998	·200	29·798	34·8	35·0	34·9	52·4	16·2	36·2	7·8	33·8	1·0	3·2	31·7	20	1·0	2·4	0·3	91	558
Feb.......	29·593	·165	29·428	29·1	29·6	29·4	48·4	11·1	37·3	11·5	28·8	0·6	2·7	26·7	11	1·4	2·0	0·2	91	557
March..	29·535	·212	29·323	37·9	38·0	37·9	57·8	24·5	33·3	14·3	36·2	1·7	4·3	33·6	12	1·5	2·5	0·4	86	546
April....	29·933	·251	29·682	45·9	45·7	45·8	72·8	25·9	46·9	20·9	42·6	3·2	7·0	38·8	4	0·1	2·9	0·8	78	544
May......	29·679	·284	29·395	49·0	48·5	48·8	81·5	28·3	53·2	19·4	45·7	3·1	6·5	42·3	12	1·8	3·3	0·8	80	536
June ...	29·863	·348	29·515	58·0	55·3	56·9	83·5	39·3	44·2	22·8	52·1	4·8	9·1	47·8	9	0·7	3·9	1·5	74	530
July ...	29·769	·444	29·325	62·2	61·8	62·1	79·0	43·7	35·3	19·2	58·2	3·9	6·6	55·5	10	5·0	5·0	1·3	80	523
Aug......	29·874	·423	29·451	62·4	61·6	62·1	79·0	47·3	31·7	19·2	57·3	4·8	8·2	53·9	10	1·1	4·7	1·5	76	525
Sept. ...	29·966	·378	29·288	57·2	56·8	57·1	78·2	34·1	44·1	20·8	53·6	3·5	6·6	50·5	6	1·1	4·3	1·1	80	532
Oct.......	29·527	·346	29·181	51·2	51·2	51·2	66·8	35·0	31·8	13·5	49·4	1·8	3·4	47·8	22	4·9	4·0	0·5	99	531
Nov.......	29·864	·250	29·614	41·3	41·3	41·3	58·0	25·7	32·3	9·7	39·9	1·4	2·8	38·5	17	1·3	2·9	0·3	92	548
Dec.......	29·761	·178	29·583	35·6	35·7	35·6	52·4	16·9	35·5	9·3	33·9	1·7	4·3	31·3	11	1·2	2·1	0·6	79	553

Explanation.

The cistern of the barometer is about 159 feet above the level of the sea, and its readings are coincident with those of the Royal Society's flint-glass barometer. The observations are taken daily at 9 A.M., noon, 3 P.M., and 9 P.M.; the means of these readings are corrected for diurnal ranges by the application of Mr. Glaisher's corrections, as published in the *Philosophical Transactions*, Part I., 1848, and from the readings of the dry and wet bulb thermometers, thus corrected, the several hygrometric deductions in columns 3, 15, 18, 19, 20 and 21, are calculated by means of Mr. Glaisher's Hygrometric Tables.

The numbers in column 2 show the mean reading of the barometer every month, or the mean length of the column of mercury which balanced the whole weight of atmosphere of air and water; the numbers in column 3 show the length of a column of mercury balanced by the water mixed with the air alone; and the numbers in column 4 show the length of a column of mercury balanced by the air alone, or that reading of the barometer which would have been had no vapour been mixed with the air.

[*Concluded on next page.*

The numbers in columns 5 and 6 are determinations of the mean temperature of the air by different instruments and methods—those in column 5 by the readings of a simple thermometer, taken at the times before-mentioned, and those in column 6 by the readings of self-registering thermometers daily. The numbers in column 12 show the mean temperature of evaporation, and those in column 15 give the mean temperature of the dew-point, or that temperature at which the vapour in the air is deposited in the form of water.

The reading of the barometer was above its average value in January, April, June, August, September, and November, and in defect in the remaining months of the year.

The mean reading of the barometer for the year, at the height of 160 feet above the mean level of the sea, was 29·780 inches, being about the average value.

The mean temperature of the air in January was in defect of the average value of 84 years by 1°; February, by 9°; March, by 3°; April was about its average value; May in defect by 3¾°; June, by 1°; July, in excess by ¾°; August, by 1½°; September, by ¾°; October, by 2°; November, in defect by 1°; and December, by 3½°; according to Mr. Glaisher's determination of the mean temperature of each month.

The mean temperature of the air for the year was 46°·9; that of evaporation was 44°·3; and that of the dew-point was 41°·5. The mean degree of humidity was 83, complete saturation being represented by 100. Rain fell on 144 days; the amount collected was 21·1 inches; being deficient by about 3 inches.

Till January 9, the weather was very warm, and the mean daily excess of temperature was 11°. On January 9, the temperature was as high as 50°; and on January 10 it fell to 26°. On the 14th, a very cold period set in, and continued with great severity till February 24; on some days, about the middle of February, the defect of temperature was as large as 15°, 16°, 17°, and 18°, on several consecutive days; and the mean daily defect for the 42 days ending February 24, was 9½°. On March 6, the cold set in again, and continued, with a few exceptions, to the end of the month. In January, the temperature was as low as 13° and 14° at different places, on different days. In February, it was as low as 3° at some places. The lowest experienced about London was 7°; the lowest observed was 0°·8 on February 18, at Berkhampstead. On this night it was 2½° at Belvor Castle, and it was low everywhere. Snow fell, replete with snow crystals; 150 distinct varieties were observed by Mr. Glaisher. See the *Report of the British Meteorological Society*, where they are all engraved.

We must go back to the year 1814 for a similar cold period. The frost in that year set in on December 26th, 1813, and was severe throughout January, and continued, with slight exceptions, till March 21st. April in 1855 was cold, and May was very cold; the temperature at night was frequently near 32°, and on the 5th was as low as 20° nearly. Snow fell at many places till the end of May. June was cold. On the day of the solstice, the temperature of vegetation was 5° or 6° below the freezing point of water. There was a white frost everywhere south of latitude 53°; thick ice was formed on ponds and still water near the south coast.

In the quarter ending September 30, there was nothing remarkable. A cold period set in at the end of October, and continued till December 17, and was very severe on December 19, 20, 21, and 22, during which period the temperature was as low as 9°, 10°, 11°, and 12°, at different places. A very sudden change set in on December 22, the temperature at night being 18°, was 20° at midnight, and increased to 50° on the 23rd; and the weather continued at a high temperature till the end of the year.

Wheat was in ear between the 15th and 30th of June; in flower between June 26 and July 3, at the different parts of the country; was cut in Ryde on July 14; at Helston, in Cornwall, on August 7; near Oxford, on the 11th; and at different dates proceeding northwards, at Aberdeen on September 10.

Barley was cut on the 15th of July, at Nottingham; and on the 30th of August at Aberdeen; and at intermediate times at intermediate places.

Oats were cut at Nottingham on July 13th; and on September 5 at Aberdeen.

Obituary.

LIST OF PERSONS EMINENT IN SCIENCE AND ART. 1855.

PROFESSOR KARL FRIEDRICH GAUSS, of Göttingen, "one of the greatest Mathematicians of ancient or modern times. His method for determining the orbit of a planet from three observations has proved of inestimable value to astronomers, more especially since the discovery of the numerous small planets revolving between the orbits of Mars and Jupiter. All his researches in mathematics and astronomy were characterized by an originality and profundity of thought, which stamp him as one of the greatest geniuses of any age or any country."—*Inverness Courier*.

COPLEY FIELDING, the distinguished Painter in Water-Colours.

G. B. GREENOUGH, Geologist and Geographer; one of the founders and first President of the London Geological Society.

SIR HENRY T. DE LA BECHE, the Geologist, under whose fostering care the Museum of Practical Geology and the School of Mines was established. (See page 237.)

M. ISABEY, the well-known Miniature-Painter to Napoleon I. and Louis XVIII.

SIR HENRY R. BISHOP, Professor of Music in the University of Oxford.

SIR GEORGE HEAD, author of *Tour through the Manufacturing Districts*.

JAMES SILK BUCKINGHAM, the traveller in the East: originator of the *Athenæum* Journal.

ADMIRAL SIR EDWARD PARRY, the Arctic Discoverer, who joined Sir John Ross's Expedition, as lieutenant, which sailed in 1818.

ANDREW CROSSE, the Electrician, whose experiments gave rise to the Crosse Mite. (See *Year-Book of Facts*, 1839, pp. 199, 200.)

DR. GEORGE JOHNSTON, Botanist and Zoologist, and specially known by his *Illustrations of British Annelides*. He was the founder of the Ray Society.

PATRICK PARK, the Portrait Sculptor.

J. F. W. JOHNSTON, Professor of Chemistry and Mineralogy in the University of Durham. His *Catechism of Chemistry and Geology* has been translated into nearly every language in Europe.

DR. J. H. GOULD, son of the eminent ornithologist. Dr. Gould had already distinguished himself by his illustration of the natural history of Scinde; and, says the *Athenæum*:—"The vigour, clearness, and accurate observation of his notes, some of which have appeared in the *Proceedings of the Zoological Society*, indicated a power of authorship which must have ultimately placed him among the most accomplished writers on India."

GEORGE PAPWORTH, Architect and Engineer.

R. C. CARPENTER, Architect of the Church of St. Mary Magdalene, Munster-street, Regent's Park.

ALFRED B. CLAYTON, Architect.

CH. DE MEYER, Naturalist, known to the scientific world by his travels among the Altai Mountains, and in the region of the Caucasus.

THOMAS WEAVER, the veteran Geologist, in the eighty-second year of his age. The contemporary of Humboldt and Leopold von Buch, he acquired, in company with these illustrious men, his rudiments of mineralogy and geology, under the tuition of Werner, at Freiburg, having been entered on the books of that celebrated Mining Academy in 1790. Mr. Weaver was, until within these few years, a frequent contributor to the *Philosophical Magazine* and other scientific periodicals.—*Athenæum*.

LEWIS WESTON DILLWYN, a Naturalist of long standing, chiefly in the study of botany and conchology. His *Descriptive Catalogue of Shells*, written prior to the publication of Lamarck's great work on the subject, is still highly valued on account of the care and diligence with which the species and synonymes of the older naturalists are worked out. Mr. Dillwyn was a member of the Royal and Linnæan Societies for more than half a century.—*Athenæum*.

PHILIP PUSEY, agriculturist.

W. B. COOKE, engraver.

The REV. RICHARD SHEEPSHANKS, F.R.S., F.R.A.S.

FRANCIS MAGENDI, French anatomist.

HERR MAELZEL, the famous musical mechanician. (See pp. 93, 94.)

GENERAL INDEX.

Note to Aluminium, pp. 148 and 188.

Among the many attractions added to the Polytechnic Institution, by the active management of Mr. Pepper, was a very fine bar of Aluminium, produced by M. St. Clair Deville (in the private laboratory of the Emperor of France), who had presented the same. After giving a brief history of the metal, the non-success of experiments for obtaining it, and the "sodium" and "voltaic battery" processes, Mr. Pepper describes its nature and properties. "Aluminium" is classed by M. Deville as an "unalterable" metal, intermediate between the precious and the more common metals. Mr. Fownes includes it in the same category as glucinum, yttrium, cerium, lanthanium, didymium, zirconium, and thorinum—all of them "metals of the earth proper." The specific gravity of aluminium is 2·56 (or 2·60 according to Mr. Fownes, water being taken as unity). This is about one-eighth of the gravity of platinum, and one-third that of iron, platinum being 20·98; gold, 19·26; mercury, 13·57; silver, 10·47; iron, 7·79; zinc, 6·5; and titanium (next above aluminium), 5·30. The equivalent of aluminium is 13·69. The metal is beautifully white, with a slight bluish tinge, and reflects light clearly. It is malleable and ductile, almost without limit; when passed through the fingers it exhales a slight odour of iron. It is a perfect conductor of electricity,—the best known among the metals,—and is negative to zinc. It melts at a rather higher temperature than zinc, and is excessively fusible. The chemical properties of aluminium are invaluable. It resists oxygen,—water has no action upon it at any temperature,—and even sulphuretted hydrogen—that great defacer of the brightness of metals in large towns—exercises no destructive influence upon it. It is now, moreover, ascertained that the metal does not decompose water. Thus aluminium bids fair to become one of the most useful and serviceable of the metals, and from it have already been manufactured some medals and watch-wheels of exquisite workmanship.

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